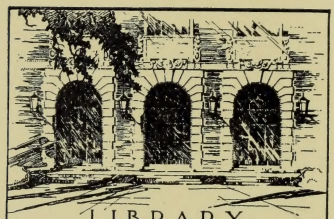

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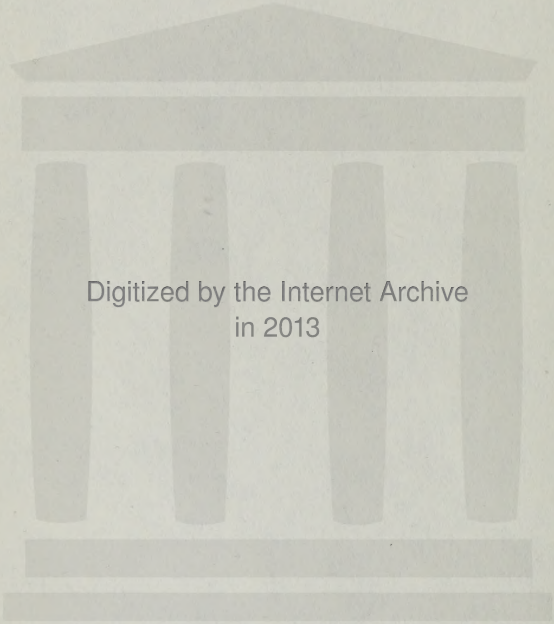
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OF

LEHIGH UNIVERSITY

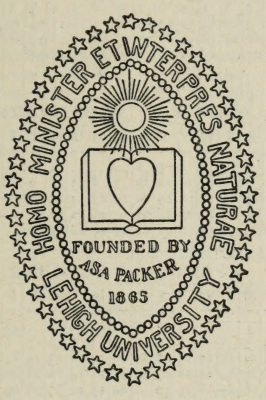
1920

BETHLEHEM
PENNSYLVANIA

REGISTER

OF

LEHIGH UNIVERSITY



1919-1920

BETHLEHEM
PENNSYLVANIA

1919

JULY

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1920

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1921

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CALENDAR

1919	1919–1920
Sept. 19, 20, 22, 23, (Friday, Saturday, Monday, Tuesday)	Examinations for admission.
Sept. 24, 3.30 P.M., (Wednesday)	First term begins.
Oct. 4, (Saturday)	Founder's Day.
Nov. 27, (Thursday)	Thanksgiving holiday.
Dec. 20, 12.00 M., (Saturday)	Christmas holidays begin.
1920	
Jan. 5, 7.45 A.M. (Monday)	Christmas holidays end.
Jan. 30, 8.00 A. M., (Friday)	Examinations begin.
Feb. 6, 5.00 P. M., (Friday)	Examinations end.
Feb. 9, 7.45 A. M., (Monday)	Second term begins.
Feb. 21, (Saturday, Washington's Birthday)	Junior Oratorical Contest.
April 24, 12.00 M., (Saturday)	Spring vacation begins.
May 3, 7.45 A.M., (Monday)	Spring vacation ends.
May 31, 8.00 A.M., (Monday)	Senior examinations begin.
June 2, 8.00 A.M., (Wednesday)	Other examinations begin.
June 9, 5.00 P.M., (Wednesday)	Examinations end.
June 12, (Saturday)	Alumni Day.
June 13, (Sunday)	Baccalaureate Sunday.
June 14, (Monday)	Class Day.
June 15, (Tuesday)	University Day.
June 16, (Wednesday)	Summer term begins.
June 16, 17, 18, 19, (Wednesday, Thursday, Friday, Saturday)	Examinations for admission.
1920	1920–1921
Sept. 17, 18, 20, 21, (Friday, Saturday, Monday, Tuesday)	Examinations for admission.
Sept. 22, 3.30 P.M., (Wednesday)	First term begins.
Oct. 2, (Saturday)	Founder's Day.
Nov. 25 (Thursday)	Thanksgiving holiday
Dec. 18, 12 M., (Saturday)	Christmas holidays begin.
1921	
Jan. 3, 7.45 A.M., (Monday)	Christmas holidays end.
Jan. 28, 8.00 A.M., (Friday)	Examinations begin.
Feb. 5, 5.00 P.M., (Saturday)	Examinations end.
Feb. 7, 7.45 A.M., (Monday)	Second term begins.
Feb. 22, (Tuesday, Washington's Birthday)	Junior Oratorical Contest.
April 23, 12.00 M., (Saturday)	Spring vacation begins.
May 2, 7.45 A.M., (Monday)	Spring vacation ends.
May 30, 8.00 A.M., (Monday)	Senior examinations begin.
June 1, 8.00 A.M., (Wednesday)	Other examinations begin.
June 8, 5.00 P.M., (Wednesday)	Examinations end.
June 11, (Saturday)	Alumni Day.
June 12, (Sunday)	Baccalaureate Sunday.
June 13, (Monday)	Class Day.
June 14, (Tuesday)	University Day.
June 15, (Wednesday)	Summer term begins.
June 15, 16, 17, 18, (Wednesday, Thursday, Friday, Saturday)	Examinations for admission.

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4 East Church Street

LEHIGH UNIVERSITY

Lehigh University was chartered by the Legislature of Pennsylvania by act dated February 9, 1866. In 1865 the Hon. Asa Packer, of Mauch Chunk, inaugurated a movement to provide an institution that would afford training and education in the learned professions as then recognized, and in technical branches, the importance of which was then just becoming apparent in the development of the industrial and transportation interests of the country. He made an initial donation of $500,000 and of a large tract of land for this purpose, to which he added largely during his lifetime and by his will.

Since its foundation the equipment and resources of the University have steadily increased due to the continued interest of the University's trustees, alumni and friends. The first important addition to the University's original plant was the Sayre Observatory, donated in 1869 by Robert H. Sayre, of Bethlehem. Later donations include Packer Memorial Church, 1887; Williams Hall, 1902; Drown Memorial Hall, 1907; the University Commons, 1907; the Wilbur Heating Plant and Engineering Laboratory, 1907; Taylor Hall, 1907; Sayre Park, 1909; the Coxe Mining Laboratory, 1910; the Fritz Engineering Laboratory, 1910; Taylor Gymnasium and Taylor Field, 1913.

Lehigh University offers the following courses:

College of Arts and Science:

1. The Course in Arts and Science.

College of Business Administration:

1. The Course in Business Administration.

College of Engineering:

1. The Course in Civil Engineering.
2. The Course in Mechanical Engineering.
3. The Course in Metallurgy.
4. The Course in Mining Engineering.
5. The Course in Electrical Engineering.
6. The Course in Chemistry.
7. The Course in Chemical Engineering.
8. The Course in Ship Construction and Marine Transportation.

Courses are described in detail on pages 31 to 75.

REQUIREMENTS FOR ADMISSION

Candidates for admission to Lehigh University must be at least sixteen years of age, must present testimonials of good moral character, and must be qualified in the entrance subjects as enumerated below.

THE COLLEGE OF ARTS AND SCIENCE

(a) Candidates for admission must present entrance requirements as follows:*

	Units
English,	3
History,	1
Elementary Algebra, A and B,	1½
Plane Geometry,	1
Latin A and B or German A or French A or Spanish A,	2
	8½

(b) Candidates must present besides the subjects in (a), 6½ units from the following:

	Units
Advanced Algebra,	½
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
Latin,	2, 3 or 4
French,	1, 2 or 3
German,	1, 2 or 3
Spanish,	1, 2 or 3
American History,	1
Ancient History,	1
Modern History,	1
English History,	1
Physics,	1
Chemistry,	1
Zoölogy,	½ or 1
Botany,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Unassigned,	½ or 1

Detailed information concerning these subjects is given on pages 20 to 27.

* A unit represents a year's study in any subject in a secondary school, constituting approximately a quarter of a full year's work. A four-year secondary school curriculum should be regarded as representing not more than sixteen units of work.

THE COLLEGE OF BUSINESS ADMINISTRATION

(a) Candidates must present the following subjects:

	Units
English,	3
History,	1
Elementary Algebra, A and B,	1½
Plane Geometry,	1
German A or French A or Spanish A or Latin A and B,	2
	8½

(b) Candidates must present besides the subjects in (a), 5½ units from the following:

	Units
Advanced Algebra,	½
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
Latin,	2, 3 or 4
French A or German A or Spanish A,	2
American History,	1
Ancient History,	1
Modern History,	1
English History,	1
Freehand Drawing,	½
Mechanical Drawing,	½
Physics,	1
Elementary Chemistry,	1
Zoölogy,	½ or 1
Botany,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Manual Training,	½ or 1
Bookkeeping, Stenography and Typewriting,	1 or 2
Industrial History,	1
Civics,	1
Economics,	1
Sociology,	1
Commercial Geography,	1

Detailed information concerning these subjects is given on pages 20 to 27.

THE COLLEGE OF ENGINEERING

(a) Candidates for admission to the Courses in Civil Engineering, Mechanical Engineering, Metallurgical Engineering, Mining Engineering, Electrical Engineering, Chemistry, Chemical Engineering, and Ship Construction and Marine Transportation must present the following subjects:

	Units
English,	3
History,	1
Elementary Algebra, A and B,	1½
Plane Geometry,	1
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
German A or French A or Spanish A,	2
	9½

(b) Candidates must present besides the subjects in (a), 4½ units from the following:

	Units
Advanced Algebra,	½
Latin,	2, 3 or 4
Greek,	2 or 3
German,	2 or 3
French,	2 or 3
Spanish,	2 or 3
American History,	1
Ancient History,	1
Modern History,	1
English History,	1
Freehand Drawing,	½
Mechanical Drawing,	½
Physics,	1
Elementary Chemistry,	1
Zoölogy,	½ or 1
Botany,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Manual Training,	½ or 1

Detailed information concerning these subjects is given on pages 20 to 27.

The detailed requirements in the various subjects are as follows:

ENGLISH

Preparation in English has three main objects: (a) command of correct and clear English, spoken and written; (b) ability to use the vernacular with accuracy, intelligence and appreciation; and (c) some acquaintance with the simpler English classics.

ENGLISH GRAMMAR AND COMPOSITION. The first two objects require instruction in grammar and compostion. English grammar should be reviewed in the secondary school; and correct spelling and grammatical accuracy should be rigorously exacted in conection with all written work during the four years. The principles of English composition governing puctuation, the use of words, paragraphs, and the different kinds of composition, including letter writing, should be thoroughly mastered; and practice in composition, oral as well as written, should extend throughout the secondary school period. Written exercises may well comprise narration, description, and easy exposition and argument based upon the principles of elementary rhetoric, as given in any approved High School Rhetoric. It is advisable that subjects for this work be taken from the student's personal experience, general knowledge, and studies other than English, as well as from his reading in literature. Finally, special instruction in language and composition should be supported by concerted efforts of teachers in all branches to cultivate in the student the habit of using good English in his recitations and various exercises, whether oral or written, making every recitation in some degree an exercise in English.

LITERATURE. The third object is sought by means of two lists of books, headed respectively *reading* and *study*; from which may be framed a progressive course in literature covering four years. In connection with both lists, the student should be trained in reading aloud and be encouraged to commit to memory some of the more notable passages both in verse and in prose.

The books for reading and study are to be selected from the groups suggested by the Conference on Uniform Entrance Requirements in English. 3 units.

HISTORY

The requirement in History is based on the recommendation of the Committee of Seven of the American Historical Association.

ANCIENT HISTORY, with special reference to Greek and Roman History, and including also a short introductory study of the more ancient nations and the chief events of the early Middle Ages, down to the death of Charlemagne (814). 1 unit.

MEDIAEVAL AND MODERN EUROPEAN HISTORY, from the death of Charlemagne to the present time. 1 unit.

ENGLISH HISTORY, with due reference to social and political development. 1 unit.

AMERICAN HISTORY AND CIVIL GOVERNMENT, with due reference to social and political development. 1 unit.

The examinations in history will be so framed as to require comparison and the use of judgment on the pupil's part rather than the mere use of memory. The examinations will presuppose the use of good text-books, collateral reading, and practice in written work. Geographical knowledge will be tested by requiring the location of places and movements on an outline map. 1 unit.

MATHEMATICS

ELEMENTARY ALGEBRA, A (ALGEBRA TO QUADRATICS). The four fundamental operations for rational algebraic expressions. Factoring, determination of highest common factor and lowest common multiple by factoring. Fractions, including complex fractions, and ratio and proportion. Linear equations, both numerical and literal, containing one or more unknown quantities. Problems depending on linear equations. Radicals, including the extraction of the square root of polynomials and of numbers. Exponents, including the fractional and negative. 1 unit.

ELEMENTARY ALGEBRA, B (QUADRATICS AND BEYOND). Quadratic equations, both numerical and literal. Simple cases of equations with one or more unknown quantities, that can be solved by the methods of linear or quadratic equations. Problems depending on quadratic equations. The binomial theorem for positive integral exponents. The formulas for the *n*th term and the sum of the terms of arithmetic and geometric progressions, with applications. ½ unit.

ADVANCED ALGEBRA. Permutations and combinations, limited to simple cases. Complex numbers, with graphical representation of sums and differences. Determinants, chiefly of the second, third, and fourth orders, including the use of minors and the solution of linear equations. Numerical equations of higher

degree, and so much of the theory of equations, with graphical methods, as is necessary for their treatment, including Descarte's rule of sign and Horner's method, but not Sturm's functions or multiple roots. ½ unit.

PLANE GEOMETRY. The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas; regular polygons and the measurements of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of line and plane surfaces. 1 unit.

SOLID GEOMETRY. The usual theorems and constructions of good text-books, including the relations of planes and lines in space; the properties and measurements of prisms, pyramids, cylinders and cones; the sphere and the spherical triangle. The solution of numerous original exercises, including loci problems. Application to the mensuration of surfaces and solids. ½ unit.

PLANE TRIGONOMETRY. Definitions and relations of the six trigonometric functions as ratios; circular measurement of angles. Proofs of principal formulas, in particular for the sine, cosine, and tangent of the sum and the difference of two angles, of the double angle and the half angle, the product expressions for the sum or the difference of two sines or of two cosines, etc.; the transformation of trigonometric expressions by means of these formulas. Solution of trigonometric equations of a simple character. Theory and use of logarithms (without the introduction of work involving infinite series). The solution of right and oblique triangles and practical applications. Candidates must bring their logarithmic tables to the examination. ½ unit.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of the metric system.

PHYSICS

The course of instruction in Physics should include:

(a) The study of some standard text-book, for the purpose of obtaining a connected view of the subject; (b) instruction by lecture table demonstrations, to be used mainly for illustration of the facts and phenomena of physics; (c) individual laboratory work consisting of at least thirty experiments.

The aim of laboratory work should be to supplement the pupil's fund of concrete knowledge and to cultivate his power of accurate observation and clearness of thought and expression. The exercises should be chosen with a view to furnishing forceful illustrations of fundamental principles and their practical applications. They should be such as yield results capable of ready interpretation, obviously in conformity with theory, and free from the disguise of unintelligible units.

1 unit.

MODERN LANGUAGES

ELEMENTARY GERMAN, A. This requirement follows, in the main, the recommendation of the Committee of Twelve of the Modern Language Association. It is expected that two whole years will be given to the work.

During the first year the work should comprise:

1. Careful drill in pronunciation.

2. The memorizing and frequent repetition of easy colloquial sentences.

3. Drill upon the rudiments of grammar, that is, upon the inflection of the articles, of such nouns as belong to the language of every-day life, of adjectives, pronouns, weak verbs and the more usual strong verbs; also upon the use of the more common prepositions, the simpler uses of the modal auxiliaries and the elementary rules of syntax and word-order.

4. Abundant easy exercises, designed not only to fix in mind the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression.

5. Reading of from 75 to 100 pages of graduated texts from a reader, with constant practice in translating into German easy variations upon sentences selected from the reading lesson (the teacher giving the English), and in the reproduction from memory of sentences previously read.

During the second year the work should comprise:

1. The reading of from 150 to 200 pages of literature in the form of easy stories and plays.

2. Accompanying practice, as before, in the translation into German of easy variations upon the matter read and in the off-hand reproduction, sometimes orally and sometimes in writing, of the substance of short and easy selected passages.

3. Continued drill in the rudiments of the grammar, directed to the ends of enabling the pupil, first, to use his knowledge with facility in the formation of sentences, and secondly, to state his knowledge correctly in the technical language of grammar. 2 units.

INTERMEDIATE GERMAN, B. This work should comprise, in addition to the elementary course, the reading of about 400 pages of moderately difficult prose and poetry, with constant practice in giving, sometimes orally and sometimes in writing, paraphrases, abstracts, or reproductions from memory of selected portions of the matter read; also grammatical drill upon the less usual strong verbs, the use of articles, cases, auxiliaries of all kinds, tenses and modes (with special reference to the infinitive and the subjunctive), and likewise upon word order and word formation. 1 unit

ELEMENTARY FRENCH, A. This requirement follows, in the main, the recommendation of the Committee of Twelve of the Modern Language Association. It is expected that two whole years will be given to the work.

During the first year the work should comprise:

1. Careful drill in pronunciation.

2. The rudiments of grammar, including the inflection of the regular and the more common irregular verbs, the plural of nouns, the inflection of adjectives, participles and pronouns; the use of personal pronouns, common adverbs, prepositions and conjunctions; the order of words in the sentence and the elementary rules of syntax.

3. Abundant easy exercises, designed not only to fix in the memory the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression.

4. The reading of from 100 to 175 pages of graduated texts, with constant practice in translating into French easy variations of the sentences read (the teacher giving the English), and in reproducing from memory sentences previously read.

5. Writing French from dictation.

During the second year the work should comprise:

1. The reading of from 250 to 400 pages of easy modern prose in the form of stories, plays, or historical or biographical sketches.

2. Constant practice, as in the previous year, in translating into French easy variations upon the texts read.

3. Frequent abstracts, sometimes oral and sometimes written, of portions of the text already read.

4. Writing French from dictation.

5. Continued drill upon the rudiments of grammar, with constant application in the construction of sentences.

6. Mastery of the forms and uses of pronouns, pronominal adjectives, of all but the rare irregular verb forms, and of the simpler uses of the conditional and subjunctive. 2 units.

INTERMEDIATE FRENCH, B. This should comprise the reading of from 400 to 600 pages of French of ordinary difficulty, a portion to be in the dramatic form; constant practice in giving French paraphrases, abstracts or reproductions from memory of selected portions of the matter read; the study of a grammar of moderate completeness; writing from dictation. 1 unit.

ELEMENTARY SPANISH, A. Two years' preparation, covering the following ground:

1. Drill in correct production of Spanish sounds.

2. The rudiments of grammar, illustrated by abundant easy exercises.

3. The reading of about 150 pages of graduated texts with constant translating into Spanish of easy variations of sentences read, the teacher giving the English.

4. Aural Drill. Practice in translating into English of Spanish words, clauses and sentences heard but not seen, the teacher giving the Spanish.

During the second year:

1. Reading of 250 to 400 pages of easy modern prose.

2. Constant practice in translating into Spanish easy variations upon the texts read.

3. Aural practice and drill in pronunciation.

4. Mastery of the form and uses of pronouns, of the subjunctive mode and of the forms of the radical changing verbs. 2 units.

INTERMEDIATE SPANISH, B. The reading of not less than 500 additional pages of Spanish prose together with the translation of at least 40 pages of simple connected English prose into Spanish. 1 unit.

LATIN

The following requirements in Latin are in accordance with the recommendation made by the American Philological Association, October, 1909.

LATIN, A and B. First and Second Year Latin. Grammar, Elementary Prose Composition. Reading of an amount not less that Cæsar, *Gallic War*, I-IV, selected by the schools from Cæsar (*Gallic War* and *Civil War*) and Nepos (*Lives*). 2 units.

LATIN, C. Third Year Latin. Reading of an amount not less than Cicero, *Orations against Catiline*, *For the Manilian Law*, and *For Archias*, selected by the schools from Cicero (*Orations*, *Letters* and *De Senectute*) and Sallust (*Catiline* and *Jugurthine War*). 1 unit.

LATIN, D. Fourth Year Latin. Reading of an amount not less than Vergil, *Aeneid*, I-VI, selected by the schools from Vergil (*Aeneid*, *Bucolics*, and *Georgics*) and Ovid (*Metamorphoses*, *Fasti*, *Tristia*, *Amores*). 1 unit.

GREEK

The following requirements in Greek are selected in as close accordance as is practicable with the recommendations of the American Philological Association.

GREEK. Grammar; Elementary Prose Composition, consisting principally of detached sentences to test the candidate's knowledge of grammatical construction; Xenophon; the first four books of the *Anabasis*; the translation, at sight, of a passage from some work of Xenophon. 2 units.

GREEK. Homer's *Iliad*, I-III: The first three books of the *Iliad* (omitting II, 494-end), and the Homeric forms, constructions, and prosody. 1 unit.

CHEMISTRY

The requirement in Chemistry is based on the report of the Committee on Chemistry of the Science Department of the National Educational Association.

ELEMENTARY CHEMISTRY. It is recommended that the candidate's preparation in chemistry include: (a) individual laboratory work, comprising at least forty exercises; (b) instruction by lecture table demonstrations, to be used mainly as a basis for questioning upon the general principles involved in the

pupil's laboratory investigations; (c) the study of at least one standard text book, to the end that the pupil may gain a comprehensive and connected view of the most important facts and laws of elementary chemistry. 1 unit.

Students, properly qualified, will be examined in Elementary Chemistry on the first Saturday of the term; those passing the examination will be privileged to omit Elementary Chemistry (390) and will, instead, take Chemistry (393) during the first term.

DRAWING

FREEHAND DRAWING. Sketching of simple geometrical figures, of objects, and from copy. At least twenty plates must be submitted. ½ unit.

MECHANICAL DRAWING. The use of instruments and the preparation of at least twenty plates, illustrating the elements of descriptive geometry or simple machine parts. ½ unit.

PHYSIOGRAPHY

PHYSIOGRAPHY. The study of a standard text-book in physical geography, that a knowledge may be gained of the essential principles, and of well-selected facts illustrating those principles. Individual laboratory work, comprising at least forty exercises with notebook, is recommended. ½ or 1 unit.

BOTANY

BOTANY. An amount equal to that contained in Bergen's *Foundations of Botany* with laboratory work. ½ or 1 unit.

PHYSIOLOGY AND HYGIENE

PHYSIOLOGY AND HYGIENE. A course covering approximately what is given in such a text-book as Huxley & Youman's *Physiology and Hygiene.* ½ or 1 unit.

ZOÖLOGY

ZOÖLOGY. The equivalent of Jordan, Kellog & Heath's *Animal Studies* with laboratory work. ½ or 1 unit.

MANUAL TRAINING

MANUAL TRAINING. Shop work in wood or metal in schools giving courses in manual training. ½ or 1 unit.

BOOKKEEPING, TYPEWRITING AND STENOGRAPHY

BOOKKEEPING, TYPEWRITING AND STENOGRAPHY, covering a formal course of study at school. 1 or 2 units.

DATES OF EXAMINATIONS

Examinations for admission to the University will be held in 1920, on Wednesday, Thursday, Friday, and Saturday, June 16, 17, 18, and 19, and on Friday, Saturday, Monday, and Tuesday, September 17, 18, 20, and 21; in 1921, on June 15, 16, 17, and 18, and September 16, 17, 19, and 20.

The examinations are held in June and September in the following order:

First Day.—Geometry, 8 A.M.; Physics, Ancient History, 2 P.M.

Second Day.—Elementary Algebra, *A*, 8 A.M. to 10 A.M., Elementary Algebra, *B*, 10 A.M. to 12 M.; Trigonometry, 2 P.M.

Third Day.—Latin, 8 A.M.; German, French, Spanish, Greek, 2 P.M.

Fourth Day.—English, 8 A.M.; History, 2 P.M.

Examination in subjects presented for elective units may be arranged by correspondence with the Registrar.

Candidates for admission wishing to obtain credit for any subject of the first term of the Freshman year should notify the Registrar before September 1.

Certificates of the College Entrance Examination Board are accepted in lieu of the entrance examinations held at the University in those subjects in which the recorded grade is C (60 per cent.) or over.

ADMISSION TO ADVANCED STANDING

Candidates for admission to advanced studies in any course are required to pass, in addition to the entrance examinations for that course, examinations in the work already done by the classes which they desire to enter. These examinations are held in September according to a fixed schedule, in the week preceding the opening of the University. The additional subjects may be found in the schedule of studies of the different departments.

A student from another college or university is admitted without entrance examinations, provided he has covered the entrance subjects required at this University and has attended another college or university for one or more complete terms. Evidence to that effect should first be filed with the Registrar. If a student has been dropped from another college or university, he must present his record to the Committee on Standing of

Students and his admission will largely depend upon the record he made in the institution from which he was dropped.

Applicants who have obtained a certificate that the entrance requirements of the University are satisfied and who desire to enter the University are advised to report personally to the Secretary of the Faculty. The Secretary of the Faculty will issue to the applicant a paper authorizing him to confer with the professors regarding the subjects for which he desires credit. It is necessary for an applicant to bring a certificate naming the subjects completed at another college, together with a copy of the catalogue or register of the college; and it is desirable for him to bring his drawings, field notes, computations and laboratory notebooks for inspection, and personal certificates from his teachers showing the grades attained at the college from which he comes. In case it is inconvenient for the applicant to report in person, he may send the credentials to the Secretary of the Faculty, who will place them before the professors and communicate the result to the applicant. Professors may admit the student to advanced standing if satisfied with thses evidences of proficiency, or they may find it necessary to give formal examinations in the subjects for which he desires credits.

Professors will note their conclusions on the paper furnished the applicant, who must return the same to the Secretary of the Faculty within the time specified on its face. If all the subjects are accepted the applicant will be admitted in full standing to the Freshman, Sophomore, or Junior Class, as the case may be. If nearly all are accepted, the candidate may be admitted with conditions, and the Secretary of the Faculty will inform him of the rules applicable to conditioned students.

Graduates of other colleges having the Bachelor's degree or its equivalent are similarly admitted to advanced standing. The length of time necessary for the completion of a course will depend entirely upon the student's attainments at entrance and his ability. Every opportunity will be given for the completion of a course in minimum time.

It is desirable that a student who anticipates taking a technical course at Lehigh University after graduation from college should so arrange his work in college as to cover as many as possible of the subjects of the Freshman and Sophomore years of the technical course he intends to enter.

ADMISSION TO GRADUATE COURSES

Students of Lehigh University who have taken their first degree, and others on presenting a diploma of an equivalent degree conferred elsewhere, are admitted to advanced studies, according to the plan to be found under the general subject of Graduate Courses.

SCHOOL CERTIFICATES

Lehigh University has no permanent arrangement with any school whereby certificates are accepted in lieu of entrance examinations.

Applicants for admission on certificate should request their school principals to send to the Registrar as soon as the school closes in June a complete record of their work. Blanks for this purpose will be supplied by the University.

Certificates are accepted in subjects in which records are satisfactory to the professors concerned and in which the work has been completed within reasonable time limits.

For admission to the College of Engineering records in mathematical subjects are accepted only if there is evidence of some satisfactory school study of mathematics completed not earlier than January of the entrance year.

For admission to the College of Arts and Science and to the College of Business Administration records in mathematical subjects are accepted only if there is evidence of some satisfactory school study of mathematics completed not earlier than June of the year preceding the entrance year.

For admission to the College of Engineering, to the College of Arts and Science and to the College of Business Administration records in the required foreign language are accepted only if there is evidence of some satisfactory school study of the language completed not earlier than January of the year preceding the entrance year.

EXAMINATIONS AT SCHOOLS

Upon the request of school principals the June entrance examinations may be held at schools on the regularly scheduled dates. Requests for examination papers should be sent to the Registrar before June 1.

THE COLLEGE OF ARTS AND SCIENCE

The College of Arts and Science of Lehigh University represents the traditional college course, modified to meet the needs of modern life and thought. Such a course is, in its purpose, primarily informing and cultural, not vocational; it seeks to gratify intellectual curiosity, to cultivate a love of learning, to impart the knowledge and discipline which are essential to intelligent and forceful living. It has besides certain specific uses: it is the customary way of approach to the professions of medicine, law, theology, and teaching, and the usual basis for graduate study for higher degrees.

The entrance requirements are liberal, and such as may be met readily by graduates of Pennsylvania High Schools of the first class. A statement of them may be found on page 17.

The plan of study comprises required subjects and unassigned or elective subjects. The required and elective subjects occupy respectively about two-thirds and one-third of the course. The required studies embrace courses in the English, German and French languages and literatures (two years each), mathematics, (trigonometry and solid geometry), chemistry (elementary chemistry and qualitative analysis), economics, history, psychology, biology, geology, and philosophy, subjects which may be regarded as fundamental to the nature and purpose of the course. In addition two periods of physical exercise weekly throughout the course are required.

The studies of the Freshman year are fixed in keeping, so far as circumstances permit, with the subjects which have been presented for entrance. After the Freshman year the course becomes increasingly elective, a minimum of three hours weekly of electives being allowed in the Sophomore year, six in the Junior year and ten in the Senior year. A member of the Faculty is appointed to counsel students in the choice of their studies, and to keep before them the importance of selecting their work, not in a haphazard way, but with a definite and consecutive plan. Students are thus dealt with individually rather than in groups, and the effort is made to suit the studies of each to his qualifications and purpose.

The minimum course of study comprises fifteen scholastic hours or periods weekly. Work is assigned on the assumption that two

hours are required by the average student to prepare adequately for a recitation. Students of proven ability, however, are not limited to this minimum after the Freshman year, and even in that year an entering student may increase his course in chemistry from three to four hours, if, as in the case of those who are preparing for the study of medicine, there is good reason. In general, the College aims at a reasonable amount of work well done, rather than a large amount indifferently done.

Instruction is given by lectures, by recitations, by the assignment of readings and topics for study and dissertations, and, when the subject admits of it, by practical work in field or laboratory. Field work or laboratory work accompanies courses in geology, physics, chemistry, biology, psychology, and allied subjects; students in advanced mathematics use, in their study of astronomy, the telescope and other intruments of the Sayre Observatory. Practice in teaching is provided in the schools of the vicinity and in the Lehigh Evening Schools for those who expect to follow teaching. Students residing at Leonard Hall who are preparing, under the direction of the Bishop of the Episcopalian Diocese of North Eastern Pennsylvania, for the theological seminary have opportunity for practical religious work.

In the following plan of study the unassigned hours are filled by subjects selected from the listed elective studies. These are not necessarily confined to the year to which in the lists they are assigned, but may be taken earlier or subsequently. But this privilege is limited by considerations of the roster and the principle that the course of each student shall be systematic and not haphazard.

Students who enter with full entrance requirements in Latin and Greek (four and three units) will ordinarily continue these studies during the Freshman year. A class in Beginners' Greek, open to Freshmen and Sophomores, is formed in alternate years. Students who begin Greek in College will ordinarily pursue the study of Greek for three years.

The degree of Bachelor of Arts (B.A.) is conferred upon graduates of the College of Arts and Science.

SCHEDULE OF STUDIES OF THE B.A. COURSE

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
English (3)	120, 121	English (3)	122, 125
Plane Trigonometry (3)	141	Solid Geometry (3)	140
German (3)	76 or 70	German (3)	76 or 71
or French (3)	98	or French (3)	99
Latin (3)	45	Latin (3)	46
or Ancient Lit. and History (3)	47	or Mediaeval Lit. and History	47
Greek (3)	55 or 64	Greek (3)	56 or 64
or Chemistry (2)	390	or Chemistry (3)	395
or Chemical Lab. (1)	392	Gymnasium (1)	500
Gymnasium (1)	500		

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
English Literature (2)	123	English Literature (2)	124
English Writing (1)		English Writing (1)	
Economics (3)	16	Economics (3)	17
Latin (3)	48	Latin (3)	49
or Greek (3)	57	or Greek (3)	58
or Physics (3)	327	or Physics (3)	327
German (3)	77 or 76	German (3)	78 or 76
or French (3)	100	or French (3)	101
Physical Education (1)	500	Physical Education (1)	500
Unassigned (3)+		Unassigned (3)+	

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Psychology (3)	1	Psychology (3)	1
French (3)	90 or 98	French (3)	90 or 99
or German (3)	70	or German (3)	71
Biology (3)	292	General Geology (2)	268
Physical Education (1)	500	Geological Lab. and Field Trips	269
Unassigned (6)+		Physical Education (1)	500
		Unassigned (6)+	

SENIOR YEAR

FIRST TERM		SECOND TERM	
Philosophy (2)	7	Philosophy (2)	8
French (3)	97 or 100	French (3)	97 or 101
or German (3)	76	or German (3)	76
Physical Education (1)	500	Physical Education (1)	500
Unassigned (10)+		Unassigned (10)+	

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

Military training under War Department R. O. T. C. regulations required, 470, 471.

ELECTIVE STUDIES

In order that elective subjects may be incorporated, so far as possible, in the University roster from term to term without conflicts, students are required to submit their elective to the Professor in charge of electives, for the first term on or before May 1, for the second term on or before December 15.

SOPHOMORE ELECTIVES

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Mod. European History (3)	41	Mod. European History (3)	41
Elementary Mechanics (3)	320	Elementary Mechanics and Heat (3)	321
Latin (3)	48	Latin (3)	49
Greek (3)	64 or 65	Greek (3)	64 or 65
Chemical Philosophy (3)	398	Advanced Chemistry (3)	399
Economic Geography (3)	35	Economic Geography (3)	35
Physiography (3)	277	Physiography (3)	278
French (3)	92	French (3)	92
or German (3)	70	or German (3)	71
History of Education (3)	10	Scientific Method (3)	19
		Physical Measurements (1)	322

JUNIOR ELECTIVES

FIRST TERM		SECOND TERM	
U. S. History (3)	39	U. S. History (3)	39
Latin (3)	50 or 52	Latin (3)	51 or 53
Greek (3)	55, 59 or 61	Greek (3)	56, 60, or 62
French (3)	98, 100 or 102	French (3)	99, 101 or 102
or German (3)	79, 77 or 76	or German (3)	79, 78 or 76
Spanish (3)	110	Spanish (3)	110
Differential Calculus (4)	146	Solid Analytic Geometry & Integral Calculus (4)	147
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
Quantitative Analysis (4)	401	Quantitative Analysis (4)	403
Constitutional Law (3)	33	Constitutional Law (3)	33
English (3)	126	Comparative Anatomy (3)	293
Mineralogy (4)	266	English (3)	128
Education (3)	10 or 11	Education (3)	11
Italian (3)	116	Italian (3)	116
Economic Geography (3)	35	Economic Geography (3)	35
Business Law (2)	31	Business Law (2)	32
Labor Legislation (2)	23	Labor Legislation (2)	23
		Geological Lab. (2)	269

SENIOR ELECTIVES

FIRST TERM		SECOND TERM	
U. S. History (3)	40	U. S. History (3)	40
Latin (3)	50 or 52	Latin (3)	51 or 53
Greek (3)	57, 59 or 61	Greek (3)	58, 60 or 62
German (3)	80 or 81	German (3)	80 or 81
French (3)	100, 102, 103 or 104	French (3)	101, 102, 103 or 104
Italian (3)	117	Italian (3)	117
Spanish (3)	112	Spanish (3)	112
Organic Chemistry (5)	408	Organic Chemistry (5)	408, 409
Banking (3)	27	Banking (3)	27
Education (3)	11	Education (3)	11
Embryology (3)	294	Botany (2)	290
Bacteriology (2)	296	Physiology (2)	298
Mental Hygiene (2)	3	Advanced Bacteriology (2)	297
Finance (3)	18	Social Psychology (2)	4
International Law (3)	34	Finance (3)	19
English (3)	130 or 132	International Law (3)	34
Physics (3)	332	English (3)	131 or 134
Analytic Mechanics (2)	149	Physics (3)	332
Field Geology (3)	275	Astronomy (3)	150
Petrography (2)	276	Palaeontology (3)	272
Differential Equations (1)	148	Geology of N. A. (3)	273
Adv. Electricity & Magnetism (2)	328	Electrical Laboratory (1)	330
Electrical Laboratory (1)	329	Analytic Mechanics (3)	152

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

PREPARATION FOR ENGINEERING COURSES

If a student in the College of Arts and Science contemplates becoming a candidate for a degree in technology or engineering after completion of his B.A. course, it is recommended that he choose as electives during the third and fourth years of his B.A. course such science studies as are contained in the first and second years of the technical course which he wishes afterwards to complete. By carefully selecting electives, with the advice and guidance of the head of his department and the professor in charge of the technical course concerned, the graduate of the B.A. course may enter the technical course chosen as a Junior in full standing, and obtain his technical degree in two years of further study.

PRE-MEDICAL COURSES

All the better grade of medical schools in the United States require for admission a high school course, such as is represented by fourteen or more college entrance units, and at least two years of work in a college of liberal arts, three-fourths of the study of

which are assigned to chemistry, physics, and biology; many of them extend their requirements to include a college degree.

Corresponding to these two classes of entrance requirements the University offers the two appended plans of study, of which the second is designed for those who will spend but two years in college in preparation for the study of medicine, the first for those who will complete the college course and obtain their degree. Since the number of students which medical colleges of standing can accomodate is limited, practical considerations alone make advisable the fullest preparation one can command. It should also be remembered that no profession brings into closer touch with humanity than that of medicine, that to none is wide and accurate knowledge more essential, and that for its study no preparation can be too good.

SCHEDULE OF FOUR-YEAR PRE-MEDICAL COURSE

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
English (3)	120, 121	English (3)	122. 125
Plane Trigonometry (3)	141	Solid Geometry (3)	140
German (3)	76 or 70	German (3)	76 or 71
or French (3)	98	or French (3)	99
Latin (3)	45	Latin (3)	46
or Ancient Lit. & History (3)	47	or Mediaeval Lit. & History (3)	47
Elementary Chemistry (2)	390	Qualitative Anal. (3)	395
Chemistry Lab. (2)	391	Stoichiometry (1)	397

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
English (3)	123, 129	English (3)	124, 133
German (3)	77 or 76	German (3)	78 or 76
or French (3)	100	or French (3)	101
Economics (3)	16	Economics (3)	17
Physics (3)	327	Physics (3)	327
Chemical Philosophy (3)	398	Advanced Chemistry (3)	399

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Psychology (3)	1	Psychology (3)	1
French (3)	90	French (3)	90
or German (3)	70	or German (3)	71
Biology (3)	292	Geology (3)	268, 269
Quantitative Anal. (4)	400, 402	Comparative Anatomy (3)	293
Theoretical Physics (2)	332	Botany (3)	290
		Physics (2)	332

SENIOR YEAR

FIRST TERM		SECOND TERM	
Philosophy (2)	7	Philosophy (2)	8
French (3)	97	French (3)	97
or German (3)	76	or German (3)	76
Organic Chemistry (5)	408, 409	Organic Chemistry (5)	410, 411
Embryology (3)	294	Physiology (2)	298
Bacteriology (2)	296	Psychology (3)	4, 6

SCHEDULE OF TWO-YEAR PRE-MEDICAL COURSE

FIRST TERM	FIRST YEAR	SECOND TERM
English (3)	120, 121	English (3) 122, 125
German (3)	76 or 70	German (3) 76 or 71
or French (3)	98	or French (3) 99
Plane Trigonometry (3)	141	Solid Geometry (3) 140
Physics (3)	327	Physics (3) 327
Elementary Chemistry (2)	390	Qualitative Anal. (3) 395
Chemistry Lab. (2)	391	Stoichiometry (1) 397

FIRST TERM	SECOND YEAR	SECOND TERM
English (3)	123, 129	English (3) 124, 133
German (3)	77 or 76	German (3) 78 or 76
or French (3)	100	or French (3) 101
Organic Chemistry (5)	408, 409	Comparative Anatomy (3) 293
Biology (3)	292	Botany (3) 290
Psychology (3)	1	Psychology (3) 4, 6
Physics (2)	332	Physics (2) 332

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

Military training under War Department R. O. T. C. regulations required, 470, 471.

COURSES FOR TEACHERS

In the course leading to the degree of Bachelor of Arts, outlined on pages 31-35, the student may, through a selection of suitable electives, equip himself to teach in the high school the subject or subjects he has selected as his specialty, whether in the field of English, of ancient or modern language, of history, of biology and chemistry, of physics and mathematics, or of physiography and related subjects. In the course in Business Administration he is permitted to substitute, during the Junior and Senior years, courses in distinctly pedagogical subjects sufficient to make a total of fifteen term hours. He may thus equip himself to teach in secondary schools the important branches of commerce and industry.

No one may teach in the public schools of any state without first securing a license from that stat.e In Pennsylvania, as in most states, the special examination for such a license is waived in the case of college graduates, provided they have completed a certain number of hours in distinctly pedagogical studies, and have applied for a provisional college certificate to teach. At the end of three years of successful experience in teaching the State of Penn-

sylvania issues a permanent college certificate. The requirement in this State for a provisional certificate calls for 200 recitation hours in such studies as psychology, history of education, school management, methods of teaching, logic and ethics. The wish is general, however, among superintendents and principals that the graduate, when he begins to teach, shall have completed a much larger amount of distinctly pedagogical study than the law now demands, and that he shall have had some experience in observation and practice teaching.

Lehigh University has endeavored to meet the wish of the school men of the State. The University Department of Education has worked out a system of giving students opportunities in observation and practice teaching. Through the courtesy and liberal spirit of Boards of Education and Superintendents of Public Schools, through the University's close association with private schools, and through the work of the Lehigh Evening School, the system of practice teaching has been made in a measure adjustable to the needs of students with different aims and at different stages in their development of teaching power.

The course in Education at Lehigh may be outlined as follows:

FIRST TERM	SOPOHMORE YEAR	SECOND TERM
History of Education (3)	10	Scientific Method (3) 9
FIRST TERM	JUNIOR YEAR	SECOND TERM
General Psychology (3)	1	General Psychology (3) 1
Secondary Education (3)	11	Secondary Education (3) 11
FIRST TERM	SENIOR YEAR	SECOND TERM
Special Method (3)	12	Special Method (3) 12

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

The courses in Mental Hygiene, Social Psychology and History of Philosophy also throw considerable light upon the true purposes of education and the methods by which to secure them.

Graduates from state normal schools will, under the conditions prescribed by the State Department of Education, receive credit for equivalent studies in the field of education completed in the normal schools.

THE COLLEGE OF BUSINESS ADMINISTRATION

Requirements for admission to the College of Business Administration are given on page 18.

The aim of the Course in Business Administration is to provide a sound understanding of the structure, organization and functioning of industry, commerce and finance, and of the general causes and criteria of prosperity and depression. A study is made of the functions common to all business enterprises and of the general principles of administration. The student is shown the relation of the business executive to the various factors of business organization and control.

In addition to providing a broad training in business, an opportunity is given to specialize in any one of a number of its branches and to prepare for the study of law. The following groupings of subjects suggest the opportunities for specialized work:

PREPARATION FOR THE LAW

Advisers: Professor Stewart and Mr. MacGregor

Business Law
Constitutional Law
International Law
Economics
Accounting Theory and Practice
Corporation Accounting
Statistics
Finance
Banking and Currency
Investments
Labor Legislation and Administration
Transportation
Psychology

ACCOUNTANCY

Advisers: Professor Stewart and Associate Professor Bickley

Accounting Theory and Practice
Corporation Accounting
Auditing
Manufacturing Accounts
Economics
Business Law
Constitutional Law
Statistics
Finance
Banking and Currency
Investments
Industrial Management
Transportation

FINANCE, BANKING AND INVESTMENT BUSINESS

Advisers: Professor Stewart and Associate Professor Bowen

Finance
Banking and Currency
Investments
Statistics
Economics
Accounting Theory and Practice
Corporation Accounting
Business Law
Transportation
Constitutional Law
Economic Geography
Industrial Management
Labor Legislation and Administration

Advisers: Professor Stewart and Associate Professor Bickley

Accounting Theory and Practice
Corporation Accounting
Manufacturing Accounts
Economics
Industrial History
Economic Geography
Construction
Engineering Drawing
Psychology
Industrial Management
Labor Legislation and Administration
Business Law
Constitutional Law
Transportation
Statistics
Finance
Investments
Electives from Courses in Engineering and Chemistry

FOREIGN TRADE

Advisers: Professor Stewart and Associate Professor Bowen

Economic Geography of the Western Hemisphere
Economic Geography of the Eastern Hemisphere
Economics
Spanish
Statistics
Business Law
International Law
Constitutional Law
Finance
Banking and Curency
Investments
Accounting Theory and Practice
Corporation Accounting

The work of the College covers four years. On its completion the degree of Bachelor of Science (B.S.) is given.

THE COURSE IN BUSINESS ADMINISTRATION

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
English (3)	120, 121	English (3)	122, 125
Spanish (3)	110 or 111	Spanish (3)	110 or 111
or Portuguese (3)	114	or Portuguese (3)	114
Industrial History (2)	38	Industrial History (2)	38
Plane Trigonometry (3)	141	Solid Geometry (3)	140
Engineering Drawing (3)	160	Engineering Drawing (2)	161
Construction (2)	162	Construction (2)	163
Science and Scientists (1)	13	Gymnasium (1)	500
Gymnasium (1)	500		

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Physiography (3)	277	Physiography (3)	278
Accounting (3)	20	Accounting (3)	21
Constitutional Law (3)	33	Constitutional Law (3)	33
Economics (3)	16	Economics (3)	17
Economic Geography of North and South America (3)	35	Economic Geography of North and South America (3)	35
Spanish (3)	111 or 113	Spanish (3)	111 or 113
or Portuguese	115	or Portuguese	115
Physical Education (1)	500	Physical Education (1)	500

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Business Law (2)	31	Business Law (2)	32
U. S. History (3)	40	U. S. History (3)	40
Labor Legislation (3)	23	Labor Legislation (3)	23
Transportation (2)	22	Transportation (2)	22
Statistics (3)	26	Statistics (3)	26
Corporation Accounting (Elect.) (3)	21	Economic Geography of the Eastern Hemisphere (3)	36
Economic Geography of the Eastern Hemisphere (3)	36	Psychology (2)	2
Psychology (2)	2	Physical Education (1)	500
Physical Education (1)	500		

SENIOR YEAR

FIRST TERM		SECOND TERM	
Finance (3)	18	Finance (3)	19
Banking and Currency (3)	27	Banking and Currency (3)	27
Investments (3)	25	Investments (3)	25
Auditing (Elect.) (2)	21a	Manufacturing Accounts (Elect.) (2)	21b
Mod. European History (3)	41	Mod. European History (3)	41
International Law (3)	34	International Law (3)	34
Industrial Management (2)	24	Industrial Management (2)	24
Physical Education (1)	500	Thesis	
		Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

Military training under War Department R. O. T. C. regulations required, 470, 471.

Students may, with the approval of the Faculty, substitute for some of the subjects in the Junior and Senior years, other subjects which will better suit their future aims.

Prospective teachers should in this connection read the statement concerning Courses for Teachers.

THE COLLEGE OF ENGINEERING

THE COURSE IN CIVIL ENGINEERING

The requirements for admission to the Course in Civil Engineering are given on page 19.

The purpose of this course is to give a broad education in those general and scientific subjects which form the foundation of all branches of technology and special training in those subjects comprised under the term of Civil Engineering. The aim of the department is to teach young men how to think and how to attack new problems, to impress upon them the underlying principles of engineering and to inspire them with a desire to do their best work.

During the Freshman year the time is devoted mostly to fundamental studies which give both general culture and preparation for the technical work of the following years. Mathematics, physics, modern languages and chemistry are given throughout both terms, the last named being taught by lectures and by practical manipulation in the laboratory. Students continue in the Freshman year the modern foreign language accepted for entrance. Drawing is done throughout the year and, as is the case in practically all the courses in drawing presented by the Civil Engineering Department, the drawing room exercises are supplemented by recitations.

The purpose of the course in Construction of the Freshman year is to give students a general idea of the scope of engineering. In this course are grouped the topics of masonry, foundations of bridges and buildings, types of retaining walls and dams, the history of architecture and engineering, street and highway construction, the history of bridges and the materials of construction. The work covers two terms and is carried on by recitations and lectures supplemented by standard books and engineering journals. Visits of inspection to structures are made and written reports on them are required.

Land and Topographic Surveying is given in the four weeks following the end of the Freshman year. By this arrangement the attention of students is concentrated upon a single subject, thus enabling practical field operations to be exemplified in the best possible manner. In Railroad Surveying of the Junior year

both preliminary and final locations of a line are made and plans, profiles and estimates of cost are prepared. In Geodetic Surveying, given in the Senior year, triangulations of a high degree of precision are executed, also determinations of azimuth and adjustments of the results are made by standard methods. A large collection of levels, transits and other surveying instruments enables the students to become familiar with instruments of the best type.

Among other required subjects is Strength of Materials, which gives the theory of beams, columns and shafts, and the methods of computing and designing them. In connection with this subject laboratory tests are made of timber, brick, iron and steel. Strength of Materials as here presented may be described as applied mechanics, that is, the application of mechanics to the design of engineering structures. The testing of materials is of great importance not only because of its effects on the student's understanding of the mechanics of engineering but because it gives him the ability to manipulate apparatus and to handle machines.

Roofs and Bridges receive attention throughout four terms. The analysis of trusses by graphic methods is given in the second term of the Sophomore year. Analytical methods of computing stresses are taken up in Roofs and Bridges of the second term of the Junior year and in Bridge Design and Bridges and Dams of the Senior year. Visits are made to bridges and to bridge shops. In the Senior year designs and working drawings are prepared by each student for both a highway and a railroad bridge. Some of these drawings are made in the same manner as in drawing rooms of bridge companies and others are general, that is, design drawings only. The theory of cantilever, draw, suspension and arch structures receives detailed attention. The design and construction of reinforced concrete are given in the second term of the Senior year in the course in Reinforced Concrete. This extended training in bridge engineering furnishes a foundation for structural steel and reinforced concrete work in practice.

Hydraulic Engineering and Sanitary Engineering are treated at length. The theory of the flow of water through orifices, weirs, pipes and channels together with the principles of hydraulic motors is given in the Junior year, the work being supplemented by testing in the hydraulic laboratory. In the Senior year subjects of water supply, water power and sewerage are discussed.

The methods of collecting, purifying and distributing water are explained and compared; house drainage, the design of sewerage systems and the disposal of sewage also receive attention. Computations for dams, standpipes, sewers and other appurtenances are made. Canal engineering, river and harbor work and land drainage receive attention. Irrigation by both water and sewage are also discussed. This training in Hydraulics and Sanitary Engineering subjects, including Sanitary Biology of the Senior year, is planned to enable a graduate to enter upon the work of city engineering. In connection with the course in hydraulics, measurements are made of the flow in the Lehigh River, the Lehigh Canal and other streams in the vicinity of Bethlehem and the data thus obtained are studied later and reports written thereon. In view of the increasing importance of water power development this work is of value and interest.

Contracts and Specifications of the second term of the Senior year is given by the Civil Engineering Department more from the engineering than from the legal viewpoint. This course, consisting of two lectures a week, gives the essential features of contracts and the form and scope of contracts and specifications as used in building engineering works.

Ship Construction and Ocean Transportation, required of Seniors in Civil Engineering, includes a brief history of ship development and treats briefly of steel design and construction, especially of the hull which is closely allied to structural design. Lectures are given concerning the planning of harbors and the design and construction of such terminal facilities as piers, dry docks and railroad facilities required at ocean terminals. Ocean trade routes, ship canals and their influence on trade routes, ocean freight rates and terminal charges are some of the phases of foreign commerce treated in this course.

A description of the Fritz Engineering Laboratory which is operated by the Civil Engineering Department is given later in this Register under the heading of Buildings.

The student who completes this course receives the degree of Civil Engineer (C.E.). Mature young men desiring to take special studies without being candidates for the degree will be afforded every facility in so doing. Graduates of this course may become candidates for the degree of Master of Science under the regulations stated elsewhere in this Register.

THE COURSE IN CIVIL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Spherical Trig. (1)	142
Chemistry Lab. (2)	391	Qualitative Analysis (3)	395
Elementary Mechanics (3)	320	Stoichiometry (1)	397
French (3)	94	Elem. Mech. & Heat (3)	321
or Spanish (3)	111	Phys. Measurements (1)	322
or German (3)	74	French (3)	94
Engineering Drawing (3)	160	or Spanish (3)	111
Construction (2)	162	or German (3)	74
Gymnasium (1)	500	Engineering Drawing (2)	161
		Construction (2)	163
		Gymnasium (1)	500

SUMMER TERM: Land and Topographic Surveying, 164.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. & Integral Calculus (4)	147
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
Mineralogy (4)	266	General Geology (2)	268
English (3)	123, 129	Geological Lab. and Field Trips (2)	269
Economics (2)	16	English (3)	124, 133
Stereotomy (3)	165	Accounting (2)	20
Physical Education (1)	500	Astronomy (2)	150
		Graphic Statics (2)	166
		Physical Education (1)	500

SUMMER TERM: Shop Work or Engineering Construction.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Strength of Materials (4)	167	Hydraulics (3)	171
Strength of Mat. Lab. (1)	168	Hydraulic Lab. (1)	172
Metallurgy (3)	248-250	Roofs & Bridges (3)	173
Heat Engines (3)	205	Heat Engines (3)	206
Analytic Mechanics (2)	149	Finance (2)	18
Business Law (2)	31	Railroad Surveying (4)	174
Engineering Problems (2)	170	Alternating Currents (2)	375
Dynamos and Motors (2)	354	Dynamo Lab. (1)	356
Dynamo Lab. (1)	355	Physical Education (1)	500
Physical Education (1)	500		

SUMMER TERM: Shop Work or Engineering Construction.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Bridge Design (2)	175	Bridges & Dams (4)	181
Bridge Design Drawing (4)	176	Sanitary Engineering (3)	182
Hydraulic Engineering (4)	177	Reinforced Concrete (4)	183
Railroads (2)	178	Contracts & Specifications (2)	184
Geodetic Surveying (3)	179	Sanitary Biology (3)	295
or Prac. Astronomy (3)	151	Ship Construction and Ocean Transportation (2)	185
Mill Buildings (2)	180	English (2)	136
Industrial Management (2)	24	Physical Education (1)	500
Physical Education (1)	500		

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

Military training under War Department R. O. T. C. regulations required, 470, 471.

THE COURSE IN MECHANICAL ENGINEERING

The requirements for admission to the Course in Mechanical Engineering are given on page 19.

The purpose of the course is to give a broad education in the various general and scientific subjects forming the foundation of all engineering and special training in the subjects pertaining to mechanical engineering in particular.

It is the aim of the Department to develop the capacity to think and to attack new problems, to ground young men in the fundamental principles of engineering as well as to inspire them with the desire to do good and thorough work.

The Freshman year is given to fundamental studies in preparation for the technical work of the following years and to studies of general cultural value. The former comprise Advanced Algebra, Analytic Geometry, Elementary Chemistry with laboratory exercises, Qualitative Analysis, Stoichiometry, Elementary Mechanics, Heat, laboratory work in Physical Measurements and a course of lectures on Engineering Construction. The cultural studies are English language and literature and modern languages,—French, German or Spanish. Students will continue the language accepted for entrance, but men who have successfully completed courses in that language equivalent to the required course at the University may take up the study of another modern language.

At the close of the second term of the Freshman year a four weeks' course is given in Constructive Elements of Machinery and of Electrical Apparatus; this course comprises a series of shop visits for the purpose of acquainting beginners with machine parts, machine tools, the usual shop-tools and various processes of manufacture. It also covers the examination of electrical instruments and machinery and the inspection of their use and operation in electrical plants. This is regarded as a desirable preliminary to the study of physics and to the electrical engineering subjects pursued later. Students may substitute two months of practical work in the shops of an industrial establishment as may be approved by the Department.

In the Sophomore year the following courses are given: Differential Calculus, Solid Analytic Geometry, Integral Calculus, Electricity and Magnetism, Light and Sound, Elementary Me-

chanics of Materials (Strength of Materials), Mechanical Drawing, Elementary Machine Design, Boilers and Steam Engines. The laboratory course covers mechanics, heat, light, electricity and magnetism. English and modern languages are continued and courses in Economics and Accounting are given.

A second summer term at the end of the Sophomore year provides a four weeks' course in shop-instruction (Mechanical Technology) which is principally devoted to familiarizing the students with those points in pattern making, moulding, forging, finishing, fitting and the construction and operation of machine tools with which they should be familiar as designers of machinery. For this course in Mechanical Technology students may substitute two months of practical shop work in industrial establishments as may be approved by the Department.

The courses given in the Junior year are Differential Equations, Analytic Mechanics, Strength of Materials, Machinery of Transmission, Graphic Statics of Mechanisms, Advanced Electricity and Magnetism, Mechanics of Machinery, Hydraulics, Kinematics, Metallurgy and Graphic Statics of Structures. Courses are given in Engineering Laboratory and Electrical Laboratory; laboratory courses also accompany the study of Strength of Materials and Hydraulics. In addition to the technical courses named there are courses in Business Law, Finance and Banking.

At the close of the Junior year a four weeks' course in Engineering Laboratory is given. As this forms a part of the series of courses in mechanical engineering laboratory work a substitution of outside work is not permitted.

The courses of the Senior year are Technical Thermodynamics, Internal Combustion Engines (Gas Engines), Machine Design, Steam Turbines and a course designated by the general term Mechanical Engineering in which one or two of the following subjects will be taken up: plant engineering, refrigeration, aeronautics, marine engines, etc. Along electrical lines the following courses are included: Dynamos and Motors, Alternating Currents, Electrical Engineering and Dynamo Laboratory. The work of the mechanical engineering laboratory is continued throughout the year. Courses in Mill Buildings, Industrial Management, and Contracts and Specifications are given.

The instruction in Machine Design begins in the first term of the Sophomore year and is continued throughout the year. There

is a thorough drill in projection drawing. In this work freehand sketches are first made and measurements taken of machine pieces; these sketches are then converted into full-sized drawings. There is then considerable practice in the interpretation of such drawings. This is followed by difficult projections and intersections and exercises in the proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice. In the last year the Seniors undertake the calculations, estimates and working drawings involved in the design of simple but complete machines. In the case of these machines the general plan of arrangement is given to the students in the form of rough sketches, photographs or wood cuts. In the second term the Seniors are expected to make original designs for simple machinery, the object of which has been fully explained.

After the students in Mechanical Engineering have completed the general course in Physics they are given courses along electrical lines. The object is to impart a clear conception of electrical units and a working knowledge of resistance, impedance, reactance, capacity, the magnetism of iron and the magnetic circuit as used in the construction of electrical machinery. Attention is then directed to the theory and calculation of direct current dynamos, to the study of variable and alternating current phenomena and to the theory of the alternating current apparatus. Practical problems are given in these subjects to show their application. The laboratory work which accompanies this special course involves tests of resistance, insulation, consumption of energy and efficiency.

The course in Engineering Laboratory begins with the handling and calibration of the instruments and appliances belonging to the experimental side of mechanical engineering. The simpler tests and experiments, along various lines, are taken up next, and there is a gradual progress toward complex operations such as the complete test of a power plant or pumping station, or a full thermodynamic test of the steam engine. The course is, at present, most fully developed in the field of steam engineering, where it embraces steam calorimetry, flow of steam, the testing of steam traps and separators; of injectors, pumps, and the steam

turbine; extensive practice with the indicator, engine tests of various sorts and boiler testing.

Gas engineering, tests of gas producers, gas engines and oil engines, work with compressed air, tests of hot-air engines, of centrifugal pumps and of various incidental appliances and apparatus are given due place in the course. Time is also devoted to dynamometer work with experiments in friction and lubrication and determination of the efficiency of machines. The purpose of this course, kept in view in the equipment and arrangement of the laboratory, is to provide a system of well-selected and graded experiments which will illustrate and impress principles, develop the skill and judgment of the student and give a broad training in the idea, method and detail of this sort of work.

In the Senior year one or two trips are made to New York or Philadelphia during which visits of inspection are made to power plants, municipal works, ship yards and a variety of industrial plants located in these cities or their immediate vicinity.

Graduates of this course receive the degree of Mechanical Engineer (M.E.).

THE COURSE IN MECHANICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Qualitative Analysis (3)	395
Chemistry Lab. (2)	391	Stoichiometry (1)	397
Elementary Mechanics (3)	320	Elem. Mech. & Heat (3)	321
French (3)	94	Phys. Measurements (1)	322
or German (3)	74	French (3)	94
or Spanish (3)	111	or German (3)	74
English (3)	120, 121	or Spanish (3)	111
Construction (2)	162	English (3)	122, 125
Gymnasium (1)	500	Construction (2)	163
		Gymnasium (1)	500

SUMMER TERM: Constructive Elements of Machinery and of Electrical Apparatus, 201, 350, or Practical Employment.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. & Integral Calculus (4)	147
Elec. & Magnetism (3)	323	Light and Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
Elem. Mech. Materials (1)	169	Steam Engines (4)	204
Drawing & El. Mach. Des. (3)	200	Elem. Machine Des. (3)	202
Boilers (1)	203	French (3)	95
French (3)	95	or German (3)	78
or German (3)	77	or Spanish (3)	113
or Spanish (3)	113	Accounting (2)	20
English (2)	123	Physical Education (1)	500
Economics (2)	16		
Physical Education (1)	500		

SUMMER TERM: Mechanical Technology, 208 or Practical Employment.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Differential Equations (1)	148	Mech. of Machinery (2)	221
Analytic Mechanics (2)	149	Plant Engineering (1)	228
Strength of Materials (4)	167	Hydraulics (3)	171
Strength of Mat. Lab. (1)	168	Hydraulic Lab. (1)	172
Machinery of Trans. (3)	212	Metallurgy (3)	248-250
Graphic Statics of Mech. (2)	209	Kinematics (4)	215
Advanced Elec. & Mag. (2)	328	Graphic Statics (2)	166
Electrical Lab. (1)	329	Electrical Lab. (1)	330
Engineering Lab. (2)	210	Engineering Lab. (1)	211
Business Law (2)	31	Dynamos and Motors (2)	354
Physical Education (1)	500	Physical Education (1)	500

SENIOR YEAR

FIRST TERM		SECOND TERM	
Thermodynamics (4)	214	Steam Turbines (4)	224
Plant Engineering (1)	228	Mech. Engineering (2)	225
Gas Engines (3)	223	Plant Engineering (2)	228
Machine Design (4)	216	Machine Design (4)	220
Alternating Currents (2)	375	Electrical Engineering (2)	361
Dynamo Lab. (1)	355	Finance (2)	18
Engineering Lab. (1)	217	Dynamo Lab. (1)	356
Mill Buildings (2)	180	Engineering Lab. (1)	222
Industrial Management (2)	24	Contracts & Specifications (2)	184
Physical Education (1)	500	Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

Military training under War Department R. O. T. C. regulations required, 470, 471.

THE COURSE IN METALLURGY

The requirements for admission to the Course in Metallurgy are given on page 19.

This course is designed to prepare the student for practice in any or all directions in the field of metallurgy, such as the extraction of metals from their ores and the working and refining of metals. The two branches of this subject formerly comprised in the separate courses of Metallurgical Engineering and Electrometallurgy have been united, so that the graduate is properly equipped in both of these directions and may properly be designated as prepared in the whole field of metallurgy.

The basis of the course is necessarily fundamental and thorough training in mathematics, chemistry and physics, followed by such advanced chemistry as is useful to the metallurgist. These fundamental studies are not cut or restricted, but are given the full prominence which they should have in a metallurgist's education.

Collateral studies in other departments than metallurgy are liberally provided, such as Mineralogy, Blowpiping, General Geology, Geological Practice and Economic Geology in the Department of Geology; Mechanical Drawing and Ore Dressing in the Department of Mining Engineering; Advanced Electricity and Magnetism and Electrical Laboratory in the Department of Physics; Alternating Currents, Dynamos and Motors, Electric Power Transmission, Electrical Engineering and Dynamo Laboratory in the Department of Electrical Engineering; Elements of Construction of Machinery, Heat Engines, comprising the study of boilers, steam engines, gas engines and internal combustion motors, and Engineering Laboratory, in the the Department of Mechanical Engineering; Hydraulics and Strength of Materials, with laboratory testing, in the Department of Civil Engineering.

Instruction in English composition, writing and oratory, in Economics, Business Law, and Contracts and Specifications is included in order to broaden the student's education. The study of German or French for one year is required, the student continuing the language on which he enters; if a student enters on Spanish he shall take one year of German. The one year of German or French is supplemented in the Senior year by read-

ings in Metallurgical German or French with the staff of the Department of Metallurgy.

The studies in chemistry, which are so important to the metallurgist, include Laboratory Experiments, Qualitative and Quantitative Analysis, both gravimetric and volumetric, of the more common ores and metallurgical products, including Gas Analysis and Assaying, along with courses in Stoichiometry, Chemical Philosophy, Advanced Chemistry, Physical Chemistry and Physical Chemistry Laboratory. This instruction, together with the course in Physics and Physical Laboratory, constitutes the foundation on which the metallurgical instruction is based.

The special instruction in Metallurgy is begun by an introductory course of lectures on the history of the metals, their economic and mechanical importance, their physical and chemical properties, including statistics of their production and details of the distribution of their ores and the geographical distribution and conditions of their production. In connection with this some visits are taken to near-by metallurgical plants to make the student familiar with the appearance and general outline of metallurgical apparatus. Courses of lectures extending over a year take up in detail the principles of metallurgy in general, that is the general physical and chemical principles utilized in extracting metals from their ores, and the manner in which they are applied. This is followed by a course of lectures on the Metallurgy of Iron and Steel, and by another course in the Metallurgy of the other metals, in which each metal is discussed in detail. In order to impress these principles upon the student and to render their application familiar, he is required to solve a series of problems dealing with practical details of the metallurgical processes in an exact and quantitative manner, the data being taken from practice and the results being intended to give an insight into the most fundamental metallurgical questions. A course of lectures follows this in the principles of electrochemistry, and their application in electrometallurgy, accompanied by laboratory investigations of these principles as well as the general principles of metallurgical processes, including methods of making physical and chemical measurements which are of value to the practicing metallurgist. A course in Metallography acquaints the student with the methods of studying with the microscope and other instruments of precision, the physical properties, constitution and structure of metals and alloys. The

course in Metallurgical Design is intended to cover the principles of designing metallurgical plant and apparatus, involving fixing the sizes and shapes of various parts of metallurgical apparatus. The seminary in the Senior year is intended to bring together the members of the Department and the students in the discussion of current metallurgical questions and problems, and students' theses.

In the summer vacations at the end of the Sophomore and Junior years the student is required, if arrangements can be made, to spend two months in practical work in a metallurgical establishment or such other plant as is approved by the Department.

The proximity of the works of the Bethlehem Steel Company and the kindness of its officers give opportunity for visits of inspection by the students in classes and individually, and thus afford unusual facilities for the practical study of the metallurgy of iron and steel. In connection with the metallurgical laboratory work, it is the practice to make investigations of the working efficiencies of furnaces in actual operation. Occasional visits of inspection are made to more distant works, in connection with the metallurgy of zinc, copper, lead, gold and silver.

Graduates of this course receive the degree of Metallurgical Engineer (Met.E.).

THE COURSE IN METALLURGY

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Qualitative Analysis (3)	395
Chemistry Lab. (2)	391	Qual. Anal. Conf. (1)	396
Elementary Mechanics (3)	320	Stoichiometry (1)	397
German (3) or French (3)	74 or 70	Elem. Mech. & Heat (3)	321
	94	Phys. Measurements (1)	322
English (3)	120, 121	German (3) or French (3)	74 or 71
Mechanical Drawing (3)	300		94
Gymnasium (1)	500	English (3)	122, 125
		Descriptive Geometry (2)	300
		Gymnasium (1)	500

SUMMER TERM: Constructive Elements of Machinery and of Electrical Apparatus, 201, 350.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. & Integral Calculus (4)	147
Quantitative Analysis (3)	401	Quantitative Analysis (3)	403
Quant. Anal. Conf. (1)	402	Quant. Anal. Conf. (1)	405
Chemical Philosophy (3)	398	Advanced Chemistry (3)	399
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
Introductory Met. (2)	244	Hydraulics (3)	171
Economics (2)	16	English (2)	124
Physical Education (1)	500	Physical Education (1)	500

SUMMER TERM: Assaying, 413, Practical Employment.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Physical Chemistry (3)	419	General Metallurgy (2)	245
Physical Chem. Lab. (1)	420	Met. of Iron & Steel (2)	246
Mineralogy (4)	266	Met. Problems (1)	247
Blowpipe Analysis (2)	267	General Geology (2)	268
Ore Dressing & Lab. (3)	302	Geological Lab. and Field Trips (2)	269
Adv. Elec. and Mag. (2)	328	Alternating Currents (2)	375
Electrical Lab. (1)	329	Electrical Eng. (2)	361
Dynamos & Motors (2)	354	Electrical Lab. (1)	330
Heat Engines (3)	205	Dynamo Lab. (1)	355
Physical Education (1)	500	Heat Engines (3)	206
		Physical Education (1)	500

SUMMER: Practical Employment.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Strength of Materials (4)	167	Electrometallurgy (1)	254
Strength of Mat. Lab. (1)	168	Metallurgical Design (2)	258
Non-ferrous Met. (4)	251	Metallurgical Lab. (2)	256
Met. Problems (1)	252	Met. Seminary (1)	260
Metallography (2)	257	Thesis (4)	261
Electrochemistry (1)	253	Engineering Lab. (1)	218
Electrochem. Lab. (1)	255	Elec. Power Transmission (3)	372
Engineering Lab. (1)	217	Economic Geology (4)	271
Electrical Lab. (1)	331	Contracts & Specifications (2)	184
Business Law (2)	31	Physical Education (1)	500
Met. French or Ger. (1)	259		
Seminary (1)	260		
Physical Education (1)	500		

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

Military training under War Department R. O. T. C. regulations required, 470, 471.

THE COURSE IN MINING ENGINEERING

The requirements for admission to the Course of Mining Engineering are given on page 19.

The object of this course is primarily to train a student for practice in the field of mining engineering. It is designed to give him the thorough fundamental training of an engineer and a breadth of education that will enable him readily to undertake work in the various lines of engineering which frequently present themselves to one of his profession.

The course, therefore, when completed, places the graduate in the path of a large number of opportunities. Not only will he have had sufficient practice and training to enter upon the field of mining, but he can also engage in work in which geology and metallurgy play an important part, as well as in engineering projects relating thereto.

The principal objects in view are that the student, upon graduation, may be enabled: first, to make and plot surface and mine surveys, and to map the topography and geology of a district; second, to analyze, value and treat minerals found upon a property, to report upon them and to analyze metallurgical products; third, to make drawings and designs to meet the requirements of given cases; fourth, to take a subordinate position as an engineer in connection with any of the previously indicated lines of work.

In the Freshman year the time is devoted to laying a foundation in the fundamental subjects of mathematics, physics, chemistry, English and modern languages. (The modern language pursued will be the one presented for entrance.)

The course in Drawing begins as soon as the student enters the University. He learns the use of drawing instruments, makes tracings and blue prints, drawings of machine parts of simple construction, and solves problems in Descriptive Geometry.

The summer schools in Land and Topographic Surveying and in Mine and Railroad Surveying are held at the close of the Freshman and Junior years respectively. The second of these schools is conducted partly in the mining regions; this gives practice in mine and railroad surveying and permits a study of mining operation and mining plants, from which data are se-

cured exemplifying class room work and facilitating the course in Mining Design of the Senior year.

The courses in Chemistry extend from the first term of the Freshman year to the summer school in Assaying at the end of the Sophomore year. Beginning with an introduction to general chemical theory and the elements, supplemented by laboratory work, the subject is continued by Qualitative and Quantitative Analysis. Chemical problems and reactions are taught in Stoichiometry. The instruction includes the analyses of common ores, fuels, gases and metallurgical products.

Courses in Economics, Accounting, Business Law, Finance, Industrial Management, Contracts and Specifications, extending over the three upper years, present to the student the several economic, commercial, administrative and legal aspects of conditions existing in the industrial world which are of particular importance to the engineering profession.

The importance of the conservation of the timber resources of the country and the preservation of wood against decay are treated in Forestry, together with the characteristics of the woods of the important timber species. The course in Biology takes up the study of living organisms, their structure, development, origin and distribution.

Mineralogy is introduced by a short course in Crystallography, in which models of crystals and mineral specimens are studied. The various means of identification are then applied to more difficult minerals, the determination of which may be assisted and effected by the work in Blowpipe Analysis.

In the courses in Geology, the student studies the forms and structures of the rock masses of the earth's crust, and the forces which modify them. A brief review of historical geology deals with the fossil life of the globe. Practice in Field Geology teaches the methods by which rock formations are accurately mapped. Economic Geology treats of the origin, mode of occurrence and distribution of the metallic and non-metallic minerals and substances of commercial value in the earth. The course in Petrography enables the student to identify the common rock-forming minerals by the use of the microscope, especially when the constituents are too fine-grained to be determined by the eye alone. Practice in the petrographic and geological laboratory

and in the field gives the student the ability to recognize the main types of rocks.

Physiography treats of the classification of land forms and their geographical distribution, their relation to geologic structure, weather and climate, and their influence upon the economic development of countries. The course in Geology of North America discusses the geologic ages and the geographic distribution of the rocks of the continent, their structure and history, and includes studies of the great surveys that have been made: Paleontology reviews animal life of the past and involves the study and identification of fossils as a means of determining the age of rocks by the principles of stratigraphy.

The course in Heat Engines includes a practical study of boilers, steam and gas engines and steam turbines; work in the Wilbur Engineering Laboratory includes tests and calculations of efficiencies and powers under varying conditions.

Strength of Materials treats of the theories which govern the strength of all kinds of common materials used in construction. Practice is given in computing and designing beams, columns, girders, etc. Hydraulics deals with the flow of liquids through orifices, mains, pipes and channels, and with the principles of hydraulic motors; practical work in the Fritz Engineering Laboratory is a part of this course. Graphic Statics gives the student the ability to compute the forces developed in roof trusses, beams and girders by the methods of graphical analysis.

The instruction in Mining Engineering is given during the Junior and Senior years, under the following subdivisions: prospecting, boring, mining or exploitation, haulage, hoisting, drainage, ventilation, lighting, first-aid, railroads, construction materials and mine administration. These subjects treat successively of the steps by which minerals are discovered and valued, the manner in which they are extracted from the earth and brought to the surface, the means by which mines are maintained in an economical condition from the viewpoint of mine owner and miner, the manner in which accidents may occur and means for guarding against them, and the treatment of injured persons.

The subject of Ore Dressing, supplemented by work in the Coxe Mining Laboratory, deals with the processes by which ores and fuels, direct from the mine, are rendered marketable. Construction Materials treats of the materials used in roads and structures in and around mines. Mine Administration discusses

the method of employing labor and of keeping accounts, mining principles and management.

The course in Oil and Gas Technology includes a study of the occurrence and distribution of petroleum and natural gas, the methods of prospecting, the means for obtaining them from the earth, and storage and transportation.

In Mining Design the student employs principles studied and observations made as the basis for designs and working drawings of parts of mining plant to fulfill given conditions.

In Metallurgy the general principles of the subject embracing fuels, furnaces and processes, are presented, followed by the metallurgy of iron and steel, copper, lead, gold, silver, zinc, tin, mercury, nickel and aluminium. Electrometallurgy familiarizes the student with the practical applications of electricity to metallurgical processes including electric-furnace practice.

Dynamos and Motors and Alternating Currents extend over the entire Senior year and embrace the study of the industrial applications of electricity which are of particular value to the mining engineer; practical work in the Dynamo Laboratory is included in these courses.

It may thus be observed that the student of the Course in Mining Engineering has studies in all of the technical departments of the University, as well as in many of the arts and science departments.

The facilities for exemplifying the work of the course are exceptional. Numerous cement mills, cement, slate and other quarries, ore and coal mines are within easy distance, and in the city are the great works of the Bethlehem Steel Company. During the Junior and Senior years all students in Mining Engineering are required to make inspection trips to the anthracite coal regions and to the metal mining districts of eastern Pennsylvania and of New Jersey and to the metallurgical works of those districts.

The Eckley B. Coxe Mining Laboratory contains the office and class rooms of the Department of Mining Engineering, the ore dressing machinery, drilling equipment, surveying instruments, and the sampling and chemical laboratories of the department.

Graduates of this course receive the degree of Engineer of Mines (E.M.).

THE COURSE IN MINING ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Spherical Trig. (1)	142
Chemistry Lab. (2)	391	Qualitative Analysis (3)	395
Elementary Mechanics (3)	320	Stoichiometry (1)	397
Spanish (3)	111	Elem. Mech. & Heat (3)	321
or French (3)	94	Phys. Measurements (1)	322
or German (3)	74	Spanish (3)	111
English (3)	120, 121	or French (3)	94
Mechanical Drawing (3)	300	or German (3)	74
Gymnasium (1)	500	English (3)	122, 125
		Descriptive Geom. (2)	300
		Gymnasium (1)	500

SUMMER TERM: Land and Topographic Surveying, 164.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. &	
Quantitative Analysis (3)	401	Integral Calculus (4)	147
Quant. Anal. Conf. (1)	402	Quant. Analysis (3)	403
Elec. & Magnetism (3)	323	Quant. Anal. Conf. (1)	405
Mech. & Heat Lab. (1)	324	Light & Sound (3)	325
Mineralogy (4)	266	Light, Elec. & Mag. Lab. (1)	326
Blowpipe Analysis (2)	267	General Geology (2)	268
Economics (2)	16	Geol. Lab. & Field Trips (3)	269
Physical Education (1)	500	Accounting (2)	20
		Physical Education (1)	500

SUMMER TERM: Assaying, 413.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Mining (4)	301	Mining (4)	303
Ore Dressing & Lab. (3)	302	General Metallurgy (2)	245
Strength of Materials (4)	167	Met. of Iron & Steel (2)	246
Heat Engines (3)	205	Met. Problems (1)	247
Petrography (2)	276	Heat Engines (3)	206
Graphic Statics (2)	166	Hydraulics (3)	171
Business Law (2)	31	Hydraulic Lab. (1)	172
Physical Education (1)	500	Physiography (2)	274
		Finance (2)	18
		Physical Education (1)	500

SUMMER TERM: Mine and Railroad Surveying, 304.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Mining (3)	305	Mining Design (3)	307
Economic Geology (2)	270	Economic Geology (4)	271
Non-ferrous Met. (3)	251	Electrometallurgy (1)	254
Dynamos & Motors (2)	354	Alternating Currents (2)	375
Dynamo Lab. (1)	355	Dynamo Lab. (1)	356
Field Geology (3)	275	Geology of N. America (3)	273
Forestry (3)	291	or Paleontology (3)	272
or Biology (3)	292	Oil & Gas Tech. (2)	306
Industrial Management (2)	24	Contracts & Specifications (2)	184
Engineering Lab. (1)	218	Engineering Lab. (1)	219
Physical Education (1)	500	Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

Military training under War Department R. O. T. C. regulations required, 470, 471.

THE COURSE IN ELECTRICAL ENGINEERING

The requirements for admission to the Course in Electrical Engineering are given on page 19.

The object of this course is to give a broad education in those general and scientific subjects which underlie all the branches of engineering, and to give special training in those technical and business subjects which experience shows are most essential in the equipment of the electrical engineer. In seeking to accomplish this object chief emphasis is laid by the Department on the mastery of principles and on thoroughness in the analysis of problems. The course includes a number of special studies in civil, mechanical and metallurgical engineering, so that the graduate in Electrical Engineering is prepared not only to enter any of the branches of electrical engineering but also to deal with related problems in the other branches of engineering. The electrical engineering graduate of today finds that professional advancement often lies through commercial, managerial or executive channels. As superintendent or manager of electric light, power or railway properties he must be prepared to handle problems involving not merely material and technical details but human relations, touching workmen, capitalists, public utility commissioners, and the public. He must know something of the principles of accounting, economics, business law and industrial management. In recognition of the fact that the largest success is generally attained by men who combine with a sound engineering foundation some knowledge of law, finance and industrial affairs, a number of such business studies have been introduced into the course.

The fundamental studies are given in the early part of the course and include mathematics, physics, chemistry, English and that modern language accepted for entrance. These subjects include the more essential features of a broad education and they furnish a preparation for the more advanced scientific and technical training to follow. At the very outset the student, through the subject Construction, imbibes the spirit of engineering. He is taught its history, development, methods and scope.

Work in applied electricity, begun during the summer term at the end of the Freshman year, is continued through the Sophomore year in the study of Electric Distribution, and

Dynamos and Motors, with Dynamo Laboratory. The Junior and Senior years are devoted almost exclusively to advanced technical work.

The study of Electricity and Magnetism constitutes an introduction to the industrial applications of electricity. Electric Distribution makes immediate application of electrical theory to the calculation of lighting and power circuits, the testing of insulation resistance and similar problems. The study also includes the installation and wiring of electrical machinery, systems of electrical distribution, outside and interior wiring and the rules for wiring prescribed by the Fire Insurance Underwriters.

The study of Dynamos and Motors includes the construction, operation and control of direct current generators and motors, with numerous illustrative problems. The study of dynamo electric machinery is resumed during the Senior year in connection with the subjects Electrical Design and Alternating Current Machinery.

Fundamental subjects in mechanical engineering are required in this course. Machine Design is given throughout the Sophomore year. Constructive Elements of Machinery is given in the summer term at the end of the Freshman year in conjunction with the work in Constructive Elements of Electrical Apparatus. Mechanical Technology is given in the summer term at the end of the Sophomore year. This is a course in shop instruction intended principally to familiarize the student with the processes involved in patternmaking, moulding, forging, fitting and finishing. Frequent visits of inspection are made to manufacturing establishments in the vicinity. Upon approval by the Head of the Department, students in Electrical Engineering will be permitted to substitute summer work in electrical shops or construction for either or both of the required summer schools. Following the work in Mechanical Technology comes the study of Graphic Statics of Mechanisms. It deals with graphic methods of determining the forces acting at all points of a machine and with the efficiency of mechanisms. Heat Engines includes the study of steam boilers, thermodynamics, steam engines and turbines, and gas engines. Engineering Laboratory is given throughout the Senior year. It includes the calibration of engineering measuring instruments and the making of practical tests on boilers, engines, pumps and other apparatus.

Important studies in Civil Engineering are included in this course. Strength of Materials is concerned with the theory of beams, columns and shafts, and the method of computing and designing them; the subject includes practical work in the testing laboratory. Hydraulics, including laboratory practice, treats of hydrostatics and theoretical hydraulics, the flow of water through orifices, weirs, pipes and channels, naval hydromechanics and hydraulic motors.

The study of General Metallurgy, Metallurgy of Iron and Steel and Metallurgical Problems is given during the second term of the Junior year. Lectures on Electrochemistry and Electrometallurgy are given during the Senior year.

Advanced studies in Electrical Engineering follow Electric Distribution, Dynamos and Motors, and Electricity and Magnetism of the Sophomore year. Advanced Theory of Electricity and Magnetism is devoted to the theory of electrical units and measurements, ferromagnetism, electromagnetism, the advanced theory of electrostatics and electric oscillations and waves, electron theory and electrolysis. The accompanying laboratory work is devoted to precise electrical measurements and the standardization and calibration of electrical measuring instruments. The Theory of Alternating Currents deals with the problems and methods of measurements which are peculiar to the modern practical applications of alternating currents and with the theory underlying the action of the important types of alternating current machinery and transmission lines. Alternating Current Machinery includes the study of the construction and operation of alternating current generators, motors, transformers and other apparatus.

The subject of Electrical Engineering deals with the application of physical principles to the solution of problems relating to direct and alternating current circuits and apparatus.

Dynamo laboratory work, beginning in the second term of the Sophomore year, is continued for five terms. Instruction is based on a laboratory manual or notes supplemented by individual direction and supervision in the laboratory. The students work individually or in pairs, and make the more important tests on direct and alternating current generators and motors, rotary converters, transformers and other electrical apparatus. Written reports of all tests made, with curves plotted from the observations and discussion of results are required.

Electrical Design, begun in the first term of the Senior year, is pursued throughout the year. It includes the application of electric, magnetic and mechanical principles to the design of various types of electrical apparatus. The instruction is given by recitations, problems and drafting.

Electrical Engineering Seminary continues throughout the Senior year. The work consists of the presentation before the class of papers on assigned topics, supplementing the regular work of the class-room and of reports on thesis work. The Department reading-room is well supplied with the leading electrical periodicals, American and foreign. One of the principal objects of the Seminary work is to encourage the systematic reading of the current engineering journals. Reports on articles in the French and German technical periodicals are included as part of the work of the Seminary.

Dynamo Testing, given by lectures and problems, treats of standard and special methods of making tests on dynamo machines, transformers and other electrical apparatus. Most of the methods discussed in the lectures are exemplified by practical testing in the dynamo laboratory.

Electric Stations takes up the location, design and equipment of stations, the selection of suitable prime movers, generators, switchboards and other apparatus. The use and operation of storage batteries, boosters and other auxiliaries receive consideration. Under Electric Traction are studied the construction, equipment and operation of different types of electric railways. The recent developments in the application of electric motive power to steam railroad conditions are discussed and the results of tests are analyzed. Practice is given in the estimating of the probable cost of building and operating an electric railway to fulfill certain specific conditions.

The subject of Electric Power Transmission deals with the various elements constituting a transmission system. It includes a study of the generating plant, the transmission line and the receiving systems. Special attention is given to the design, construction and protection of the line. Under the last three subjects are included visits of inspection to electric light and power stations and manufacturing establishments in Bethlehem and elsewhere. Central station tests are made and reports are required.

Graduates of this course receive the degree of Electrical Engineer (E.E.).

THE COURSE IN ELECTRICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Qualitative Analysis (3)	395
Chemistry Lab. (2)	391	Stoichiometry (1)	397
Elementary Mechanics (3)	320	Elem. Mech. & Heat (3)	321
French (3)	94	Phys. Measurements (1)	322
or German (3)	74	French (3)	94
or Spanish (3)	111	or German (3)	74
English (3)	120, 121	or Spanish (3)	111
Construction (2)	162	English (3)	122, 125
Gymnasium (1)	500	Construction (2)	163
		Gymnasium (1)	500

SUMMER TERM: Constructive Elements of Machinery and of Electrical Apparatus, 201, 350, or Electrical Shops.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. & Integral Calculus (4)	147
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
Elem. Mech. Materials (1)	169	Dynamos and Motors (3)	352
Elec. Distribution (2)	351	Dynamo Lab. (1)	353
Drawing & El. Mach. Des. (3)	200	Machine Design (3)	202
English (3)	123, 129	Graphic Statics of Mech. (2)	209
Economics (2)	16	Accounting (2)	20
Physical Education (1)	500	Physical Education (1)	500

SUMMER TERM: Mechanical Technology, 207 or Electrical Shops.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Advanced Elec. & Mag. (2)	328	Alternating Currents (2)	359
Analytic Mechanics (2)	149	Electrical Engineering (2)	360
Differential Equations (1)	148	Dynamo Testing (1)	364
Theory of Alt. Cur. (3)	357	Dynamo Lab. (1)	362
Dynamo Lab. (1)	358	Electrical Lab. (1)	330
Electrical Lab (1)	329	Heat Engines (3)	206
Heat Engines (3)	205	Hydraulics (3)	171
Strength of Materials (4)	167	Hydraulic Lab. (1)	172
Strength of Mat. Lab. (1)	168	Finance (2)	18
Business Law (2)	31	Metallurgy (3)	248-250
Physical Education (1)	500	Physical Education (1)	500

SUMMER TERM: Electrical Engineering Inspection, 376; Electrical Shops.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Alt. Current Machinery (4)	363	Electric Traction (3)	371
Dynamo Lab. (3)	366	Dynamo Lab. (2)	374
Dynamo Testing (1)	365	Elec. Power Trans. (3)	372
Electrical Design (3)	367	Electrical Design (2)	370
Electrical Seminary (1)	369	Electrical Seminary (1)	373
Electric Stations (2)	368	Electrometallurgy (1)	254
Electrochemistry (1)	253	Engineering Lab. (1)	218
Engineering Lab. (1)	217	Contracts & Specifications (2)	184
Industrial Management (2)	24	Thesis (3)	377
Physical Education (1)	500	or Elec. Communication (3)	378
		Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

Military training under War Department R. O. T. C. regulations required, 470, 471.

THE COURSE IN CHEMISTRY

The requirements for admission to the Course in Chemistry are given on Page 19.

This course, leading to the degree of Bachelor of Science in Chemistry, offers an education primarily in chemistry, with some training in related sciences. The modern conception of an education in chemistry includes a simultaneous, thorough study of physics and mathematics. In addition to these so-called physical sciences, other studies, planned to develop and aid the thought-processes and culture of the student, are embodied in the course. Aside from preparation for the life of a professional chemist, it is well adapted for teachers of chemistry and as a course preliminary to the study of medicine.

This course and the Course in Chemical Engineering are both given under the direction of the Department of Chemistry, and facility is offered for changing from either course to the other at the end of either term of the Freshman year. The entrance subjects required are the same in both courses (see page 19), and the tuition and laboratory costs are practically the same. Subjects with the same title in the tabulated curricula (see pages 67 and 72) are given to students in both courses simultaneously and under the same teachers, and are equal in content. Details of chemistry subjects are described in the course in Chemical Engineering.

French and German receive considerably more attention in the course in Chemistry, both as language tools for the working chemist and in their cultural aspects. Students who enter the University on French continue in that language through the Freshman year, and take up German through the Sophomore and Junior years. Those who offer German as an entrance subject continue in that language through the Freshman and Sophomore years and study French through the Junior year. Students who offer Spanish for entrance take German through the Freshman and Sophomore years, and French through the Junior year.

Biology is placed in the Senior year and is taught in the Biology Department of the University. It is of great value in establishing clear ideas of plant and animal organisms, their functions and interrelations, all of which are of interest to the

scientist in chemistry; and, furthermore, the laws and theories of biology are of great moment in current intellectual and civic life. This subject is presented in lectures supplemented by work in the laboratory on higher and lower organisms. The course in Bacteriology of the Senior year is given in the same department.

Mineralogy receives full consideration in the first term of the Junior year, developing the physical and chemical characteristics of minerals, and their recognition in specimens. The study of crystallography is included. Geology follows in the second term of this year.

Economics throughout the Junior year and Modern European History through the Senior year are the full courses given under these headings in this University by the Department of History and Economics. The same department supervises the Summer Reading in Economics, embracing such subjects as origins of industry and their relations to science, the economic import of inventions, industrial management, business law and custom and contracts. The topics for Summer Reading are also correlated in the lectures under the heading Economics, mentioned above. It is believed that this course of reading and study under expert guidance will inculcate an appreciation of the profit and pleasure to be derived from a continued interest in history and economics.

In order to acquaint the student with factory methods and personnel, a required summer term of work in factory or laboratory is set for the vacations following the Freshman and Juniors years. Young men of exceptional ability and ambition are encouraged to enroll in subjects given in the University not listed in the Course in Chemistry, subject to Faculty rules.

The foregoing course will serve as an excellent preparation for graduate study; students who desire to go forward to the Master's Degree (M.S.) will find information on page 132 of this Register.

THE COURSE IN CHEMISTRY

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Chemistry (1)	394
Chemistry Lab. (2)	391	Qualitative Analysis (3)	395
Elementary Mechanics (3)	320	Qual. Anal. Conf. (1)	396
Dr. & El. Mach. Des. (3)	200	Stoichiometry (1)	397
French (3)	94	Elem. Mech. & Heat (3)	321
or German (3)	75 or 72	Phys. Measurements (1)	322
English (3)	120, 121	French (3)	94
Gymnasium (1)	500	or German (3)	75 or 72
		English (3)	122, 125
		Gymnasium (1)	500

SUMMER TERM: Work in Industrial Shop or Laboratory. Summer Reading in Economics, 30.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. & Integral Calculus (4)	147
Chemical Philosophy (3)	398	Advanced Chemistry (3)	399
Quantitative Analysis (3)	400	Quantitative Analysis (4)	404
Quant. Anal. Conf. (1)	402	Quant. Anal. Conf. (2)	405
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
German (3)	77 or 75 or 72	German (3)	78 or 75 or 72
English (3)	123, 129	Physical Education (1)	500
Physical Education (1)	500		

SUMMER TERM: Assaying, 413. Summer Reading in Economics, 30.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Quantitative Analysis (2)	406	Organic Chemistry (4)	410
Quant. Anal. Conf. (2)	407	Organic Chem. Lab. (4)	411
Organic Chemistry (3)	408	General Metallurgy (2)	245
Organic Chem. Lab. (2)	409	Met. or Iron & Steel (2)	246
Mineralogy (4)	266	Met. Problems (1)	247
Economics (3)	16	General Geology (2)	268
French (3)	90	Economics (3)	17
or German (3)	75	French (3)	90
Physical Education (1)	500	or German (3)	75
		Physical Education (1)	500

SUMMER TERM: Work in Industrial Shop or Laboratory. Summer Reading in Economics, 30.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Physical Chemistry (3)	419	Physical Chemistry (2)	421
Physical Chem. Lab. (1)	420	Physical Chem. Lab. (1)	422
Industrial Chem. Lab. (3)	412	Research Chem. Lab. (2)	423
Non-ferrous Met. (4)	251	Industrial Analysis (3)	416
Met. Problems (1)	252	Industrial Anal. Conf. (1)	417
Biology (3)	292	Sanitary Chem. Lab. (2)	418
Bacteriology (2)	296	History of Chemistry (1)	424
History (3)	41	History (3)	41
Physical Education (1)	500	English (2)	136
		Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

Military training under War Department R. O. T. C. regulations required, 470, 471.

THE COURSE IN CHEMICAL ENGINEERING

The requirements for admission to the Course in Chemical Engineering are given on page 19.

This course of study is designed to prepare the student for the profession of Chemical Engineering in the construction, control and management of manufacturing establishments which utilize principles of chemistry and its allied arts. Aside from the primary requirement of chemistry, the modern development of the chemical engineer enforces a thorough knowledge of physics and mathematics, together with sound understanding of such fundamentals in mechanical and electrical engineering as will make him a discriminating research and operating engineer.

Elementary Chemistry, begun in the Freshman year, in lectures with demonstrations, text-books and recitations, is supplemented by experiments in the laboratory which develop manipulative skill and make careful observation habitual. An alternate course, less elementary in both class-room and laboratory, is given to entering students who have had a considerable training in elementary chemistry. (See page 27.)

After this preliminary view of the elements of chemistry, there is developed that deeper insight into the changes of matter which is the particular province of general chemistry. In Chemical Philosophy of the Sophomore year particular attention is paid to the theories and modern concepts of chemistry, including solution, equilibrium and energy relations of molecules and of atoms, radio-activity, etc.,—a kind of junior physical-chemistry of the greatest, everyday importance in chemical engineering. This study is continued as Advanced Chemistry, covering a moderately advanced study of chemical substances, their preparation and properties, together with elementary consideration of phase rule and of such general applications as the relations underlying desirable properties in alloys, iron and steel, etc.

Organic Chemistry is taught during the entire Junior year by means of lectures, recitations and laboratory work. The aim of the course is to familiarize the student with the simpler compounds of carbon, and later so to amplify the instruction that he shall become versed in the usefulness of this branch of chemistry in science, in the chemistry of animal and plant life, and in the

manufacture of such chemical products as dyes, drugs and medicines, oils, fats, waxes, and many others.

Introduction to the chemical analysis of substances is begun through Qualitative Analysis in the second term of the Freshman year. This is a laboratory course, proceeding from the recognition of individual substances to the analysis of more complex solutions and solids. Lectures and recitations to elucidate the facts and theories underlying analytical chemistry accompany the laboratory work. The simpler mathematical relations of chemical processes are reviewed under Stoichiometry and are illustrated through many problems solved by the student. Quantitative Chemical Analysis by gravimetric, volumetric and electrolytic methods follows through the Sophomore year and the first term of the Junior year, and takes up the analysis of ores, fuels, metallurgical products, commercial chemicals and by-products. Frequent class-room conferences accompany the laboratory work and elucidate the calculations involved and the scientific foundations of quantitative analysis. The analysis of industrial organic substances and of food-stuffs, drinking and boiler waters is placed in the final term of the Senior year, when the student has a better foundation in increasing experience and a broader outlook toward the important significance of Industrial Chemistry. At this stage, too, is placed the sampling and analysis of illuminating and heating gas, flue gases and other special gases.

Fire-assaying of ores and of gold and silver bullion is taught in the summer term after the Sophomore year when continuous attention throughout the day can be given to muffles and furnaces. The practice in Assaying is accompanied by extensive consideration of the calculations and theories involved in the production of mixtures favorable for the work in hand. A course in Industrial Mineralogy is a part of this summer work, and leads to familiarity with about seventy-five minerals of commercial importance. These minerals are studied in their crystalline forms, also in the forms in which they often present themselves for final utilization by the chemical engineer.

The laboratory methods of Physical Chemistry and the systematic, deeper study of generalizations of chemistry learned in the Sophomore year are reserved for the Senior year under Physical Chemistry. Interrelations of the fundamentals of matter and energy are developed under such cognate headings as two-phase

and multiphase systems, thermodynamics, gas reactions, mass action, electrochemistry, colloid chemistry, etc. Attention is given to the usefulness of Physical Chemistry in the solution of manufacturing problems in Chemical Engineering.

Intensive instruction in the application of factory methods in Chemical Engineering is likewise placed in the Senior year and is grouped under Industrial Chemical Laboratory and Industrial Chemistry. The processes reviewed are varied; such as transportation of gases, liquids and solids; grinding, pulverizing; mechanical, hydraulic and pneumatic separation; evaporation; distillation; filter pressing; centrifuging; autoclaving. Characteristics and adaptability of engineering materials used in apparatus and machines receive full discussion. Selected industries are investigated and explained. Familiarity with manufacture in its scientific and economic aspects is promoted in the special laboratory fitted with industrial apparatus, the student finally submitting full working specifications for a plant designed for the preparation of some industrial product, together with estimates of cost of raw materials and cost of conversion into finished product. Lehigh University is fortunately situated in a district abounding in business enterprises which involve chemical engineering and visits are made to these plants and to factories in the nearby cities of Philadelphia and New York.

In Research Chemical Laboratory of the last term in the Senior year every student is required to solve a novel problem having a scientific basis and is expected to demonstrate some ability as an independent research worker. A short course in History of Chemistry, with individual reading of significant records, co-ordinates the past progress of the science and leads to a nobler pride and an enhanced initiative in the profession which the graduate enters.

Metallurgy and related subjects are taken in the Department of Metallurgy. Instruction in mechanical engineering, so important to the chemical engineer, is given by the Mechanical Engineering Department. Mechanical drawing and the laying out of machine elements in the Sophomore year are followed in the Senior year by the calculations for, and design of some such pieces of machinery as jaw crushers and stirrer autoclaves. In the interim Mechanical Engineering is developed in Steam and Gas Engines of the Sophomore year, in the Engineering Laboratory of the Junior and Senior years and in the Engineering

Laboratory of the summer term following the Junior year. A first acquaintance with Constructive Elements of Machinery and of Electrical Apparatus is acquired in the summer term following the Freshman year. An elementary course in the Mechanics of Materials accompanies the instruction of the first term of the Sophomore year. Many of the problems and innovations of Chemical Engineering demand a more intimate knowledge of the principles and practice of Electrical Engineering than is given in the general course in Physics; this is provided for in the Junior year under Advanced Electricity and Magnetism of the Department of Physics, and under Dynamos and Motors and Alternating Currents, with their laboratory adjuncts, of the Department of Electrical Engineering. A comprehension of the scope and general methods of Geology and Bacteriology is attained in short courses in these subjects. Bacteriology is a lecture and laboratory course, and a working knowledge of bacteriological methods as applied to water and some industrial products is achieved.

In addition to the usual courses in English of the beginning years, a course in English is provided for the Senior year, by which time, it is hoped, the student will have a mature appreciation of values. The study of German, a necessary tool in current chemistry, is carried by all students in the Freshman year, and provision is made for needful knowledge of French. Students who present German or Spanish for entrance will take French in the Senior year, and those who present French for entrance will take additional German in the Senior year.

An approach to the affairs of men and the problems of business and civilization is carried in some period of all four years, and is under the direction of the Head of the College of Business Administration. The full course of lectures in Economics as given in the University is placed in the Junior year. Related reading is specified as summer work, and examination in this requirement is held on the first Saturday following the opening of the first term. Summer reading comprises such matter as origins of industry and their relation to science, industrial management, business law and custom and contracts.

A scientific society is attached to the Department, with a membership of teachers and students, for the presentation of papers, discussion of current journals, and the entertainment of speakers of note in the profession of chemical engineering.

The degree granted on completion of the course is Chemical Engineer (Ch.E.).

THE COURSE IN CHEMICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Chemistry (1)	394
Chemistry Lab. (2)	391	Qualitative Analysis (3	395
Elementary Mechanics (3)	320	Qual. Anal. Conf. (1)	396
Dr. & El. Mach. Des. (3)	200	Stoichiometry (1)	397
German (3)	72 or 75	Elem. Mech. & Heat (3)	321
English (3)	120, 121	Phys. Measurements (1)	322
Gymnasium (1)	500	Elem. Mech. Materials (1)	169
		German (3)	72 or 75
		English (3)	122, 125
		Gymnasium (1)	500

SUMMER TERM: Con. Elements of Mach. and of Elec. Apparatus, 201, 350, or industrial work. Summer Reading in Economics, 30.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. & Integral Calculus (4)	147
Chemical Philosophy (3)	398	Advanced Chemistry (3)	399
Quantitative Analysis (3)	400	Quantitative Analysis (4)	404
Quant. Anal. Conf. (1)	402	Quant. Anal. Conf. (2)	405
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
Machine Design (3)	202	Steam & Gas Engines (4)	207
English (2)	123	Physical Education (1)	500
Physical Education (1)	500		

SUMMER TERM: Assaying, 413, and Industrial Mineralogy, 414. Summer Reading in Economics, 30.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Quantitative Analysis (2)	406	Organic Chemistry (4)	410
Quant. Anal. Conf. (2)	407	Organic Chem. Lab. (4)	411
Organic Chemistry (3)	408	General Metallurgy (2)	245
Organic Chem. Lab. (2)	409	Metallurgy of Iron (2)	246
Advanced Elec. & Mag. (2)	328	Met. Problems (1)	247
Dynamos & Motors (2)	354	Alternating Currents (2)	375
Dynamo Lab. (1)	355	Dynamo Lab. (1)	356
Engineering Lab. (2)	209	General Geology (2)	268
Economics (3)	16	Economics (3)	17
Physical Education (1)	500	Physical Education (1)	500

SUMMER TERM: Engineering Laboratory, 212. Summer Reading in Economics, 30.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Physical Chemistry (3)	419	Physical Chemistry (2)	421
Physical Chem. Lab. (1)	420	Physical Chem. Lab. (1)	422
Industrial Chem. Lab. (3)	412	Industrial Chemistry (3)	415
Non-ferrous Met. (4)	251	Research Chem. Lab. (2)	423
Met. Problems (1)	252	Industrial Analysis (3)	416
Engineering Lab. (1)	216	Industrial Anal. Conf. (1)	417
Bacteriology (2)	296	Sanitary Chem. Lab. (2)	418
Electrochemistry (1)	253	Electrometallurgy (1)	254
Electrochemical Lab. (1)	255	History of Chemistry (1)	424
Machine Design (2)	208	French (3)	105
Physical Education (1)	500	or German (3)	73
		English (2)	136
		Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

Military training under War Department R. O. T. C. regulations required, 470, 471.

THE COURSE IN SHIP CONSTRUCTION AND MARINE TRANSPORTATION

The requirements for admission to the Course in Ship Construction and Marine Transportation are given on page 19.

The purpose of this course is to prepare men to engage in the design, construction and operation of ships, and to enter the field of marine transportation. The course is a combination of engineering and economics preceded by the fundamental subjects common to engineering courses: chemistry, modern languages, physics and mathematics. Combining, as it does, engineering training with studies in economics and business administration, such a course offers great advantages. It has been planned to develop a class of men, who in addition to a knowledge of conditions governing ocean and inland water transportation, will have a command of the technical, economic, and financial problems of ship design, construction and operation.

The first and second years are devoted largely to physics, modern languages, chemistry, engineering drawing, and mathematics, all of which afford necessary preparation for the technical work in later years. The course in construction taken throughout the Freshman year is designed to give students a general idea of the scope of engineering. Students continue in the Freshman year the modern foreign language accepted for entrance. In the Sophomore year they may elect French, Spanish or German.

The second year schedule, although largely concerned with sciences, embraces some preliminary work in engineering and economics. There is a detailed study of ship construction, including lectures and class room work covering the main features of ship construction, and also work in the drawing room where drawings of ship construction are worked up by the student. In the second term the student fairs up a set of ship's lines and cuts a model from his own lines. Both the transverse and longitudinal types of construction are given full treatment in this course. The study of naval architecture is begun in the second term of the second year and is continued in the first term of the Junior year.

The Junior year schedule includes these fundamental engineering subjects: Strength of Materials, Hydraulics, Naval Architecture, Steam Engineering, Machine Design, Marine Engineering, and Electrical Engineering. Class room work in most of the subjects is supplemented by exercises in the laboratories. In the first term of the third year a study is made of the theory of heat engineering and thermodynamics. This course is followed in the second term by a study of marine engineering with special emphasis on the selection and layout of the marine power plant and economic problems in marine engineering.

The work in the Senior year completes the work in Naval Architecture and takes up the study of Ship Design, Marine Engines and Turbines, Metallurgy, Structural Steel Design and Reinforced Concrete, economics, and marine transportation.

An important feature of the Lehigh Course in Ship Construction and Marine Transportation is the large amount of time devoted to the study of economics and allied subjects. To arouse the student's interest and to fit him for work in marine transportation and foreign trade, instruction in Economics and Accounting is given in the Sophomore year, followed by Business Law and Finance in the Junior year, and by Marine Insurance and Foreign Exchange, Foreign Trade, and Industrial Management in the Senior year.

Surveying is given during four weeks of the summer term immediately following the close of the Freshman year.

Students are encouraged to obtain summer work in shipyards and on shipboard, and the department co-operates in finding positions for them. The summer following the Sophomore year should be spent in a shipyard. This brings the student into direct contact with practical ship construction and shipyard practices, so that he unconsciously acquires a knowledge of proportions and dimensions of engineering structures. The summer following the Junior year should, if possible, be spent at sea so that the student may observe the action of a ship at sea, and study the operation of the ship's power plant.

(A special pamphlet is issued describing this course in detail.)

Graduates in this course receive the degree of Naval Engineer (N.E.).

THE COURSE IN SHIP CONSTRUCTION AND MARINE TRANSPORTATION

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Spherical Trig. (1)	142
Chemical Lab. (2)	391	Qualitative Analysis (3)	395
Elementary Mechanics (3)	320	Stoichiometry (1)	397
French (3)	94	Elem. Mech. & Heat (3)	321
or Spanish (3)	111	Physical Measurements (1)	322
or German (3)	74	French (3)	94
Engineering Drawing (3)	160	or Spanish (3)	111
Construction (2)	162	or German (3)	74
Gymnasium (1)	500	Engineering Drawing (2)	161
		Construction (2)	163
		Gymnasium (1)	500

SUMMER TERM: Land and Topographic Surveying.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. & Integral Calculus (4)	147
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
English (3)	123, 125	English (3)	124
French (3)	91 or 95	French (3)	91 or 95
or Spanish (3)	110 or 113	or Spanish (3)	110 or 113
or German (3)	70, 77	or German (3)	71, 78
Ship Construction (3)	450	Naval Architecture (2)	452
Economics (2)	16	Ship Construction (2)	451
Physical Education (1)	500	Accounting (2)	20
		Physical Education (1)	500

SUMMER TERM: Work in Shipyard on Hull Construction.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Strength of Materials (4)	167	Hydraulics (3)	171
Strength of Materials Lab. (1)	168	Hydraulic Lab. (1)	172
Naval Architecture (3)	453	Alternating Currents (2)	375
Dynamos & Motors (2)	354	Dynamo Lab. (1)	356
Dynamo Lab. (1)	355	Marine Engineering (3)	455
Heat Engineering (3)	226	Machine Design (3)	202
Business Law (2)	31	Steam Engineering Lab. (1)	217
Astronomy & Navigation (2)	150	Finance (2)	18
Physical Education (1)	500	European History (3)	41
		Physical Education (1)	500

SUMMER TERM: At Sea or in Shipyard Machine Shop.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Naval Architecture (2)	454	Metallurgy (3)	248, 250
Ship Design (3)	457	Ship Design (4)	458
Marine Engines & Turbines (4)	227	Reinforced Concrete (3)	186
Steam Engineering Lab. (1)	227	Contracts & Specifications (2)	184
Structural Steel Design (4)	456	Foreign Trade (4)	29
Industrial Management (2)	24	Shipyard Plants & Terminal Facilities (3)	459
Foreign Exchange & Marine Insurance (3)	28	Physical Education (1)	500
Physical Education (1)	500		

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

Military training under War Department R. O. T. C. regulations required, 470, 471.

LIST OF STUDIES

Following is a complete list of studies offered by the University in its various courses. The number of exercises a week in each subject is indicated by the figures in parentheses. Two hours of drawing, three of work in the laboratory or three of practice in the field are regarded as equivalent to a recitation or lecture of one hour's duration.

UNDERGRADUATE COURSES

PHILOSOPHY, PSYCHOLOGY AND EDUCATION

PROFESSOR HUGHES, ASSISTANT PROFESSOR DROWN

PSYCHOLOGY

1. General Psychology. A text in applied psyschology is first studied, with a view to introducing the student to the purpose and methods of modern psychology. Many class experiments are performed. Subsequently the principles of psychology are surveyed in some detail, and their importance illustrated in respect to many social, industrial, medical and educational problems. Hunter, McDougall, Thorndike, and periodicals. First and second terms (3).

2. General Psychology. A course similar to that outlined under 1. First and second terms (2).

3. Mental Hygiene. An introduction to the study of exceptional mental conditions. First term (2).

4. Social Psychology. The relation to essential human needs of the several forms of culture,—sport, art, the moral and religious consciousness, the spirit of science; their origin and development. Second term (2).

5. Economic Psychology. A critical study of some of the popular literature in this field. Hollingworth's *Applied Psychology*. A course especially intended for students in engineering. First and second terms (1).

6. Experimental Psychology. A course for Seniors who wish to follow up some line of investigation touched on in the Junior year. First and second terms (1).

PHILOSOPHY

7. History of Philosophy. An introduction to the philosophical method of dealing with the essential problems of an epoch. Rogers' *Student's History.* First term (2).

8. History of Philosophy, continued. The philosophical enterprises of recent years. Perry's *The Present Conflict of Ideals.* Second term (2).

9. Scientific Method. The history of science, with some analysis of the methods introduced at different stages and in the several fields of science. Practice in presenting and dissecting arguments. Second term (3).

EDUCATION

10. History of Education. Special emphasis is placed upon Greek education and upon the roots of our present educational systems and methods. Graves. First term (3).

11. Secondary Education. The curriculum and methods of the modern high school. Inglis' *The Principles of Secondary Education,* followed by readings in the current literature of educational science and practice. Recitations, observations and reports. First and second terms (3).

12. Special Method. The work of the Senior year is given to preparation for the type of position which the student hopes to fill. It includes a study of recent discussions and educational experiments. Observation of high school classes, with practice teaching, is required. The following professors have arranged to give courses in special method in the studies named: French, Professor Fox; German, Professor Palmer; Latin, Professor Blake; science, Professor MacNutt. First and second terms (3).

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13. Science and Scientists. A survey of the development of scientific method, with a study of the lives of certain scientists. The relation of science to invention. First term (1).

BUSINESS ADMINISTRATION

PROFESSOR STEWART, ASSOCIATE PROFESSOR BOWEN, ASSOCIATE PROFESSOR BICKLEY, MR. MACGREGOR

ECONOMICS

16. Economics. A study of the elementary principles of political economy. Lectures and required reading in selected works. First term (3), (2) or (1).

17. Economics. Practical economic problems; taxation, transportation, finance, labor, trusts, and monopolies. Second term (3), (2) or (1).

18. Economics. Finance. Discussion of public expenditures; their nature, their relation to the industrial, political, and social conditions; their relation to the functions of government. First term (3), or second term (2).

19. Economics. Finance. Discussion of public revenues; of revenue derived from the public domain and public industries; the apportionment, classification, and administration of taxes; the nature and employment of public credit; the origin and growth of public debts. Second term (3).

20. Accounting Theory and Practice. A study of the fundamental principles of accounting with sufficient practice work to illustrate these principles. Theories of debit and credit; single and double entry; construction of accounts; special books; distinction between capital and revenue and the problems involved; construction and analysis of financial statements; equity accounts; valuation of assets; methods and problems of depreciation. The economic aspects of accounting are emphasized. First term (3), or second term (2).

21. Corporation Accounting. (Elective, Junior year.) The application of accounting principles to corporations, corporation accounts and records. The voucher system; construction and analysis of corporate statements and reports; assets of corporations and their valuation; capital stock and the stock books; bonds and other forms of indebtedness; distribution of profits; handling surplus and reserves; sinking and other funds; liquidation of a corporation; combinations and consolidations; branch house accounting. Considerable practice work is given during the second term. The problems are selected largely from examinations for Certified Public Accountancy. First and second terms (3).

21a. Auditing. (Elective, Senior year.) Procedure in conducting an audit; detection of errors and defalcations; financial condition of a business as revealed by the accounts and other sources of information. The social responsibilities of auditing. First term (2).

21b. Manufacturing Accounts. (Elective, Senior year.) The various systems of manufacturing accounts for different types of manufacturing enterprises; choice of methods to meet peculiar

needs; installing cost systems; forms and records; manufacturing accounts as an aid to and as a check on production efficiency; preparation of reports for executives. Second term (2).

22. Transportation. Development of transportation facilities. The course considers from the administrative viewpoint railways and waterways as factors in the social and industrial development of the United States. The organization of railways, considering charters and franchises, capital stock, directors and stockholders. The administration and operation of railways, considering the activities of the various departments,—transportation, traffic, executive, financial, and legal. Relations between railroads and their employees. Public regulation and control of transportation facilities. First and second terms (2).

23. Labor Legislation and Administration. Labor problems confronting the employer and the more successful methods of meeting them and avoiding legal disputes. The legal status of unions and strikes. Protection of the employer's interests. Employer's Liability and Workmen's Compensation Acts. First and second terms (3).

24. Industrial Management. Practical problems confronting the industrial manager. Factors determining the location of industry. Nature of plant structure and arrangement of process. Methods of wage payment. The human element in industry. First and second terms (2).

25. Investments. A comparative study of investment values (including bonds, stocks, notes, and mortgages) and the conditions affecting the investment market; with the emphasis on the securities of corporations as investments. First and second terms (3).

26. Statistics. Statistical method and applied statistics. Practice is given in the handling and especially in the interpretation of statistics. As much research as possible is carried on. First and second terms (3).

27. Banking and Currency. A study of the banking system of the United States, comparing it with those of the important European states, together with a study of the currency and currency problems of this country. Special emphasis is laid upon the Federal Reserve Act, foreign exchange, and factors affecting the money market. First and second terms (3).

28. Foreign Exchange and Marine Insurance. Foreign monies and exchange ratios, financing of exports and imports, factors de-

termining exchange rates, statistical studies in the field of foreign exchange, instruments and forms used in foreign trade; principles of insurance and the peculiarities of marine risks and policies. First term (3).

29. Foreign Trade. An historical and statistical study of international trade; the organization of steamship lines; combines, export associations, and rate agreements; line and charter traffic and trade routes. A study of steamship ports and the influence of the hinter land with special attention to the relations of navigation or inland waterways and railway transportation to ocean commerce. The course also includes a study of the special methods necessary for successful trading with certain undeveloped but progressing nations. Second term (4).

30. Summer Reading in Economics Assignments for summer of 1920: Freshman: Resources. *The Conservation of Natural Resources*, Charles R. Van Hise. Sophomore: Industrial Society. *Readings in Industrial Society*, Leon C. Marshall. Junior: Industrial Administration. *The Works Manager Today*, Sidney Webb; *Organizing for Work*, H. L. Gantt; *Instincts in Industry*, Ordway Tead.

LAW AND POLITICAL SCIENCE

31. Elements of Business Law. The principles of contract; formation of contracts; operation and discharge of contracts; sales of goods; insurance contracts; negotiable instruments. First term (2) or (1).

32. Elements of Business Law. Principal and agent; master and servant; business associations; partnerships and corporations. Second term (2) or (1).

33. Constitutional Law. The constitutional framework and the practical operation of the Federal and State governments. The relation of government to the business and social interests of the people. Interpretation of the Constitution by the various departments of the government. Comparison of American and European practice. First and second terms (3).

34. International Law. The development of international law; its origin and history; economic and political changes determining the development of international relations; the Jus Gentium of the Roman Law and the "Natural Law" jurists. Law of Peace and War: general principles governing the normal relations of states and their relations in time of war. The Law of

Neutrality, with special reference to the contributions of the United States; problems associated with blockade, contraband of war, unneutral service. First and second terms (3).

ECONOMIC GEOGRAPHY

35. Economic Geography of North and South America. Physical features, climate, and resources of the Western Hemisphere; their influence upon the economic, political, and social institutions. Particular attention is given to the present and prospective commercial relations of the United States with Mexico, Central and South America. First and second terms (3).

36. Economic Geography of the Eastern Hemisphere. Physical features, climate, and resources of the Eastern Hemisphere. Their influence upon the economic, political, and social institutions. Emphasis is put upon the study of Great Britain, Germany, Russia, China, Japan, India, and the Philippine Islands. The present and prospective commercial relations of these countries with the United States. First and second terms (3).

HISTORY

PROFESSOR STEWART, MR. MAC GREGOR

38. Industrial History. Special attention is directed to the evolution of modern industrial conditions as found in the growth of the economic powers of Great Britain, Germany and the United States. First and second terms (2).

39. The Political and Constitutional History of the U. S. Prior to 1860. The era of constitution making, state and federal. Rise and growth of party government. The development of nationality and democracy. Political and constitutional questions arising in connection with internal improvements, the tariff, the bank and slavery. First and second terms (3).

40. Political and Constitutional History of the U. S. Since 1860. A continuation of the preceding course. Given alternately with Course 41. First and second terms (3).

41. History of Europe in the Nineteenth Century. The narrative history of the period is followed, with special emphasis on such topics as the political and economic reconstruction of Europe after the Napoleonic Wars, the revolutionary movements of 1848, the rise of Socialism, the unification of Italy and of Germany, the agrarian problem in Russia and the Balkan problem. First and second terms (3).

42. American Foreign Relations. Studies in the diplomatic relations of the United States with the main countries of Europe, with the Near East and the Far East. First term (3).

43. United States and Latin America. Problems arising out of the relations of South American states to one another and to the United States. Origin, development and application of the Monroe Doctrine. Second term (3).

LATIN

PROFESSOR BLAKE

45. Livy. Selections from the books covering the war with Hannibal. Particular attention to forms and the usages of normal syntax. Latin prose compositions using Arnold's *Latin Prose*. Written translations from Latin into English. History of the struggle between Rome and Carthage. Freshman, first term (3).

46. Horace. *Odes* and *Epodes*. Insistence upon tasteful trans lation. Constant practice in metrical reading. Memorizing of some of the odes of Horace. Latin prose composition, continued. Freshman, second term (3).

47. Ancient and Mediaeval Literature and History. The course aims to impart a knowledge of ancient and mediaeval civilization and literature by means of required readings in available English translations of writings of the times, as well as by means of text-books dealing with the course of events. Freshman, first and second terms (3).

Courses 45 and 46 are required of Freshmen in the B.A. course who enter with four units in Latin; others in that course take 47, except that those who present three units in Latin for entrance may, upon the approval of the Professor of Latin, continue Latin instead.

48. Pliny. Selected letters. Tacitus. *Agricola* and *Germania*. Consideration of social and legal usages suggested by Pliny. Some study of Roman provincial administration. Sophomore, first term, elective (3).

49. Plautus and Terence. Careful study of a play of each, with rapid reading of as much more as the time permits. Study of dramatic verse-structure and practice in metrical reading. History of the drama at Rome. Sophomore, second term, elective (3).

50. Tacitus. Selections from the *Histories* or *Annals*. Some consideration of Tacitus as an historian and a literary artist.

Sight-reading from Suetonius. Junior or Senior, first term elective (3).

51. JUVENAL. Selected *Satires*. Selections from Martial. Satire and epigram in Roman literature. Study of social conditions under the empire as evidenced by the writings of the younger Pliny, Tacitus, Suetonius, Juvenal, and Martial. Writing of brief dissertations on assigned topics. Junior or Senior, second term, elective (3).

52. ROMAN LAW. An elementary course. Selections from the Institutes of Justinian, or Gaius, are read and commented on. Brief survey of Roman constitutional history and the development and content of the body of Roman Law, in connection with Morey's *Outlines of Roman Law*. Junior or Senior, first term, elective (3).

53. LUCRETIUS. Careful study of one book entire of *De Rerum Natura*, with reading of selections from the other books. Consideration of textual questions. Discussion of ancient materialistic theories. Some review of Roman philosophy and ethics. Junior or Senior, elective, second term (3).

54. Courses for prospective teachers of Latin in secondary schools. Largely a review of secondary school Latin, the members of the class conducting the class in turn under the oversight of the Professor of Latin to the end that they may enter upon the teaching of Latin in preparatory or high school with freshened knowledge of the subject, and not without some experience in presenting it. Junior year, first term (2), second term (2). This course will ordinarily be taken in connection with EDUCATION, which see.

GREEK

PROFESSOR GOODWIN

55. LYSIAS, Selected *Orations*; or XENOPHON, *Memorabilia*. Review of the Grammar. Composition and other exercises. Attic prose syntax is carefully studied, and special attention given to the formation of correct methods of study and translation, to grammatical analysis, and the reading aloud of Greek. Available time is employed in sight-reading. HERODOTUS. One book begun. First term (3).

56. HERODOTUS (continued). Study of the forms and syntax of the Ionic dialect. PLATO. *Euthyphro* and *Apology*, or other

shorter dialogues. Introduction to Greek Philosophy. Grammar and Composition as in the first term. Second term (3).

57. THUCYDIDES. One or more books. Practical exercises, including composition, are given from time to time. First term (3).

58. TRAGEDY. EURIPIDES. *Medea*, *Bacchae*, or another play. SOPHOCLES. *Oedipus Tyrannus*, *Antigone*, or another. Literary study of the drama. Poetical language, style, and conception. Metrical reading. Composition. Second term (3).

59. DRAMATIC POETRY (continued). AESCHYLUS. *Agamemnon*, or *Prometheus Bound*. ARISTOPHANES. *Clouds*, *Frogs*, or *Birds*. ARISTOTLE. Chapters from the *Poetics*. Aristophanes as humorist and as moralist, with consideration of the tendencies which he satirized. Metres. Elementary text-criticism. First term (3).

60. GREEK ORATORY. Jebb's *Selections from the Attic Orators*. DEMOSTHENES. Selected orations. The reading is rapid, and the student is supposed to have reasonable facility in understanding the Greek directly without rendering into English. Attention is directed largely to those points which illustrate the development of Greek prose style. Second term (3).

61. HOMER. Considerable portions of the *Iliad* or *Odyssey* are rapidly read. Homeric language, syntax, and metre are reviewed, with some reference to the needs of intending teachers, but chiefly as a foundation for the study outlined in course 62. First term (3).

62. LYRIC POETY. Fragments of the Elegiac, Iambic, and Melic Poets. Selections from PINDAR, or THEOCRITUS. Study of the development of poetry in Greece. Second term (3).

63. HELLENISTIC GREEK. *New Testament*. Selections from LUCIAN. To be substituted on occasion for 62. Second term (3).

Courses 59 and 61, 60 and 62 are given in alternate years, and are open to both Juniors and Seniors.

Candidates for honors in Greek will be assigned special readings on request.

64. ELEMENTARY GREEK. This course is offered in alternate years to Freshmen or Sophomores who have entered without Greek, but desire to take up the study in college. They perform in two years approximately the amount of work required for admission from those who present Greek, and are prepared to proceed in the third year with Course 55. The introductory book

and a portion of the *Anabasis* are studied in the first two terms. Given in 1919-1920; to be omitted in 1920-1921. First and second terms (3).

65. ELEMENTARY GREEK, second year. *Anabasis* continued; *Iliad*; Grammar and simple Composition. Omitted in the years in which the preceding course is given. First and second terms (3).

GERMAN

PROFESSOR PALMER,

ASSISTANT PROFESSOR MORE, MR. ROEST, MR. HAUSSMANN

70. ELEMENTARY GERMAN. German Grammar and Composition. Easy German texts. First term (3).

71. ELEMENTARY GERMAN, continued. Composition based on work in the Grammar. Dictation. Reading of short stories by various modern authors. Second term (3).

72. ELEMENTARY GERMAN. A condensed course for Chemical Engineers who have entered without German. Grammar. Readings in the German of Chemistry. First and second terms (3).

73. SCIENTIFIC GERMAN. Rapid reading of scientific texts. For Seniors in the Department of Chemical Engineering who offered French or Spanish for entrance. Prerequisite course 72 or equivalent. Second term (3).

74. GERMAN. Thorough review of German Grammar. Prose composition. Modern German Prose; Scientific German. First and second terms (3).

75. GERMAN. The German of Chemistry. Review of German Grammar. Composition. First and second terms (3).

76. GERMAN. German Prose and Poetry. Heine, Keller, C. F. Meyer, Freytag, Storm, Heyse. Composition. First and second terms (3).

77. GERMAN. Modern German Prose. Rapid reading of representative texts. First term (3).

78. GERMAN. Goethe's *Faust*. Study of Part I. Lectures on the origin and development of the Faust story. Second term (3).

79. GERMAN. Nineteenth Century German Drama. Lectures, reading, reports on assigned work. First and second terms (3).

80. GERMAN. Goethe's Dramas: *Goetz*, *Egmont*, *Iphigenie*, *Tasso*, *Faust*, Part II. First and second terms (3).

81. GERMAN. The German Short Story, its origin and development. Rapid reading of illustrative stories, with particular attention to Gottfried Keller, Theodor Storm, C. F. Meyer, and Paul Heyse. Lectures and reports. First and second terms (3).

ROMANCE LANGUAGES

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY,
MR. SOURBER, MR. CASTILLO

FRENCH

90. Elementary French. Elementary French Grammar. Easy readings in French prose. Practice in speaking and writing simple French, based upon the texts used. A course intended primarily for Junior students in the College of Arts and Science; introductory to Course 97. First and second terms (3).

91. Elementary French. An elective for Sophomore students in the course in Ship Construction and Marine Transportation. Emphasis is laid upon the development of a reading knowledge of French. Grammatical drill is limited to the essentials. First and second terms (3).

92. Elementary French. A Sophomore elective for students in the College of Arts and Science who wish three years of French and can therefore give time to a more detailed drill in grammar and composition as well as practice in writing and speaking; introductory to French 98. First and second terms (3).

93. French. A course for students who wish a greater opportunity for practice in the oral and written use of modern French prose. Especially recommended for those who expect to teach French. First and second terms (2).

94. French. A course for Freshmen who enter on French. Thorough review of the grammar with composition work, both oral and written, based upon the grammar and upon the texts read. Texts are selected from writers of modern French prose. First and second terms (3).

95. French. Primarily for Mechanical Engineering Sophomores as a sequence of Course 94 and for students in Ship Construction and Marine Transportation who elect to continue the French of their Freshman year. The work includes rapid reading of modern French authors, introducing certain of the social and political problems of France and her people today. Texts by such authors as Thiers, Lamartine and Michelet are read to furnish the necessary background. First and second terms (3).

96. French. Texts and methods. First or second term, or both (1) or (2).

97. FRENCH. Rapid reading. Sight translation. Dictation. Oral drill in the use of a practical vocabulary. First and second terms (3).

98. FRENCH PROSE AND POETRY. Balzac, Flaubert, Maupassant, Daudet, Zola. First term (3).

99. FRENCH PROSE AND POETRY. Continuation of course 98. Molière, Corneille, Racine. Society in the seventeenth century. Second term (3).

100. FRENCH. French literature in the seventeenth century. First term (3).

101. FRENCH. French literature in the eighteenth century. Second term (3).

102. FRENCH. French literature in the sixteenth century and earlier. First and second terms (3).

103. FRENCH. General review of French Literature. Reading, lectures and explanation of texts. First and second terms (3).

104. FRENCH. French literature in the nineteenth century. First and second terms (3).

SPANISH

110. SPANISH. Grammar, reading and composition. A course open to all students of the University. First and second terms (3).

111. SPANISH. Preparation required: 110 or equivalent. Reading and discussion in Spanish of texts dealing with the history of Latin America countries. Prose Composition. First and second terms (3).

112. (Alternate.) Spanish novels and plays. Short outline of Spanish literature. This is a second year course, intended more especially for students in the B.A. course and may be substituted by them for course 111, dealing with Latin America. First and second terms (3).

113. SPANISH. Reading and discussion in Spanish of texts dealing with the commercial and industrial relations of Latin America. Spanish commercial correspondence. First and second terms (3).

PORTUGUESE

114. PORTUGUESE. Grammar and composition. Rapid reading of modern literature, with particular reference to the history,

social and economic conditions of Brazil and Portugal. First and second terms (3).

115. PORTUGUESE. A continuation of course 114. First and second terms (3).

ITALIAN

116. ITALIAN. Grammar and composition. Rapid reading of easy modern prose. First and second terms (3).

117. ITALIAN. Dante's *Inferno*. Interpretation, lectures and outside reading. First and second terms (3).

ENGLISH

PROFESSOR THAYER, PROFESSOR LUCH,
ASSISTANT PROFESSOR MESCHTER, ASSISTANT PROFESSOR WALTERS,
MR. MENGEL

120. RHETORIC. A composition course based on Genung's *Working Principles of Rhetoric* and other books, involving recitations and weekly themes on assigned subjects. First term (2).

121. AMERICAN LITERATURE. Lectures on the basis of Cairns' *History of American Literature* and other text-books, as assigned. The examination is based upon the text-book and the student's notes. First term (1).

122. HISTORY OF THE ENGLISH LANGUAGE. Lectures and classroom work, with the use of Emerson's *Brief History of the English Language* as a text-book, supplemented by Lounsbury's and Champneys'. Second term (2).

123. ENGLISH LITERATURE. An outline course developed by lectures and recitations, with parallel readings assigned annually. Text-book: Pancoast's *English Literature* with a standard book of selections from English Literature. First term (2).

124. LITERARY CRITICISM. The subject varies annually between topics taken from Elizabthan Literature, lyric or dramatic, and from Nineteenth Century Literature, earlier or later period. Second term (2). In 1921, Byron, Shelley, Keats, and Landor.

125. ORATORY. A formal course based upon Foster's *Argumentation*, with recitations and writings of briefs, the composition and delivery of orations, and speeches on topics of current interest. First and second terms (1).

126. ANGLO-SAXON. Sweet's *Anglo-Saxon Primer and Reader*, with lectures on early English Literature, and readings from Brooke and Earle. First term (3).

127. JOURNALISM. A course of practical exercises in writing on scientific subjects and in the principles of journalism. Text-books: Bleyer's *Newspaper Writing and Editing* and Earle's *Technical Writing*. First term (3), repeated in second term (3).

128. ENGLISH PHILOLOGY. The principles of the Philology of the English language as developed in the works of Earle, Trench, Morris and Skeat. By a process of elimination the elements derived from Romance and other sources are excluded, and the residuum examined, in vocabulary and grammar, as a Teutonic language; with special reference to the intensive development of the tongue before the Age of Chaucer. Preparation required: 126. Second term (3).

129. NINETEENTH CENTURY LITERATURE; later period 1830-1892. A special study of Tennyson, Arnold and Browning and the Pre-Raphaelites. First term (1).

130. MIDDLE ENGLISH. A critical study of the English of Chaucer, Langland, Wiclif, and Gower; followed by the literary study of selected specimens of their works. As text-books, *The Student's Chaucer*, Skeat's edition of *The Vision of Piers the Plowman*, Wiclif's translation of the *New Testament*, revised by Purvey, and Gower's *Confessio Amantis* are assigned. First term (3).

131. POETICS. A course based on Gummere's *Handbook of Poetics*, Alden's *English Verse*, Saintsbury's *Loci Critici*, and the use of Palgrave's *Golden Treasury*, and *The Oxford Book of English Verse*, with practical exercises in verse-composition. Second term (3).

132. DRAMA OF THE PAST. Based on Brander Matthew's *Chief European Dramatists*; with lectures, interpretations and a close study of plots and sources. First term (3).

133. CONTEMPORARY DRAMA. Lectures, criticisms and reading of typical plays. Second term (1).

134. THE DANISH ELEMENT IN ENGLISH. A philological study based on Sweet's *Icelandic Primer*, Groth's *Danish Grammar* (pp. 1-29, 67-143) and the works of Jespersen and other philologists. Alternative with 130. Preparation required: 126, 128. Second term (3).

135. Optional courses on the Rise and Development of the English Novel and on the Arthurian Cycle are offered in alternate years. These are both lecture courses, with private reading assigned; and if supplemented by a rigid examination, will be

taken as equivalent to one term's work in any class above the grade of Freshman.

136. English Conferences. Second term (2).

MATHEMATICS AND ASTRONOMY

PROFESSOR THORNBURG, PROFESSOR LAMBERT, PROFESSOR OGBURN, ASSISTANT PROFESSOR STOCKER, ASSISTANT PROFESSOR REYNOLDS, ASSISTANT PROFESSOR KNEBELMAN, DR. LEYZERAH, MR. SOLT

140. Solid Geometry, beginning with Book VI and completing the subject. Second term (3).

141. Trigonometry. Plane Trigonometry, including the theory and use of logarithms. First term (3).

142. Trigonometry. Spherical Trigonometry, including the use of logarithmic tables. Second term (1).

143. Advanced Algebra, beginning with the Theory of Quadratic Equations. First term (3).

144. Higher Algebra. Theory of Equations and other topics. First term (1).

145. Plane Analytic Geometry. Graphic representation of loci on cross-section paper, plane analytic geometry. Second term (3).

146. Differential Calculus. Embracing applications to analytic geometry and practical problems. Preparation required: 145. First term (4).

147. Solid Analytic Geometry and Integral Calculus. General integration methods with applications to theory of center of gravity, moment of inertia, together with a short chapter on elementary ordinary differential equations. Preparation required: 146. Second term (4).

148. Differential Equations. Preparation required: 147. First term (1).

149. Analytic Mechanics. Differential equations of motion, treatment of forces in space, free and constrained motion of a particle and of masses, with applications to practical problems. Preparation required: 147. First term (2).

150. Descriptive Astronomy. A study of the fundamental facts and principles of the subject with solution of problems; observatory visits. First and second term (2) or (3).

151. Practical Astronomy. Study of instruments used, methods of taking and reducing observations to determine time, latitude, longitude, and azimuth; observatory work in which each student

makes his own observations and computations in illustration of the problems studied. As this study is primarily for civil engineers, the sextant and engineer's transit are the chief instruments employed in the observational work. Preparation required: 147, 150. First term (3).

152. Analytic Mechanics. Preparation required: 147, 148, 149. Second term (3).

CIVIL ENGINEERING

PROFESSOR FOGG, PROFESSOR WILSON, ASSOCIATE PROFESSOR CHAPMAN, ASSISTANT PROFESSOR BECKER, ASSISTANT PROFESSOR FULLER, ASSISTANT PROFESSOR PAYROW, MR. LEWIS, MR. UHLER

160. Engineering Drawing. The use of drawing instruments. Lettering and tracing. Mechanical drawing from objects. Simple projections. Isometric drawing. First term (3).

161. Engineering Drawing. The descriptive geometry of projections, intersections, and developments. Plans, elevations and sections of simple structural details. Preparation required: 160. Second term (2).

162. Construction. Lectures planned to give the student a general view of various branches of engineering. The principal topics discussed are: history of engineering, including the lives of some noted engineers and scientists; history and types of architecture; modern building construction, including steel frames and fire-proofing; masonry; types of retaining walls and dams; materials of construction; water supply and sewage disposal; development and transmission of water power; history of bridges. First term (2).

163. Construction. Lectures and recitations on foundations, especially of bridges and buildings; street and highway construction. Computations for foundations of simple structures. Second term (2).

164. Land and Topographic Surveying. The theory and practice of land surveying, including computation of areas, dividing land, determining heights and distances. Map drawing and topographic signs. Field work with level and transit. Map drawing from students' field notes. Theory and use of stadia. Detailed field work in rough country; pen topography and contour maps. Illustrations with and problems in the sand box. Preparation required: plane trigonometry and mechanical drawing. Summer

term; a recitation and seven hours of field work or drawing each week-day for four weeks beginning June 16, 1920.

165. Stereotomy. Problems in stone cutting, including plans for piers, culverts, and arches. Isometric drawings and linear perspective. Preparation required: 160, 161. First term (3).

166. Graphic Statics. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to the discussion of beams and girders. First or second term (2).

167. Strength of Materials. The elasticity and strength of timber, brick, stone, and metals. Theory of beams, columns, and shafts, with the solution of many practical problems. Preparation required: 320, 321, 323, 147. First term (4).

168. Strength of Materials Laboratory. Each student makes fourteen experiments on wood, iron and steel to determine the action of materials under stress and to study the physical properties of materials of construction. The Fritz Engineering Laboratory, wherein this work is done, is equipped with 20,000, 50,000, 100,000, 300,000, and 800,000-pound machines for tension, compression, and flexure, a 50,000-inch-pound machine for torsion and other apparatus for special work. Preparation required: 167. First term (1).

169. Elementary Mechanics of Materials. Brief introduction to elements of strength of beams, columns and shafts, especially as applied to elementary machine design. First term (1), or second term (1).

170. Engineering Problems. Applications of mathematics, mechanics, heat, electricity, light, sound, and strength of materials to practical engineering problems. Preparation required: 167. First term (2).

171. Hydraulics. Hydrostatics and theoretical hydraulics. The flow of water through orifices, weirs, tubes, pipes, and channels. Naval hydromechanics. Hydraulic motors. The solution of many practical problems. Preparation required: 320, 321, 323, 147. Second term (3).

172. Hydraulic Laboratory. Each student makes fourteen experiments in the hydraulic section of the Fritz Engineering Laboratory, which is equipped with pumps, weirs, turbines, waterwheels, meters and other apparatus for special work. Preparation required: 171. Second term (1).

173. Roofs and Bridges. The theory and computation of stress in roof and bridge trusses under dead, live and wind loads. Loco-

motive wheel loads on plate girders and bridge trusses. Preparation required: 167. Second term (3).

174. Railroad Surveying. Reconnaissance, preliminary and location methods, with the theory of curves and turnouts. Location of a line, with the preparation of profiles and maps. The computation of earthwork and estimates of cost. Preparation required: 164. Second term (4).

175. Bridge Design. Lectures and recitations. Discussion of the theory of structural steel design and complete calculations for a through plate girder railroad bridge and for a highway truss bridge, both of which are designed and drawn in course 176. Preparation required: 173. First term (2).

176. Bridge Design Drawing. Complete shop drawing for a single track through railroad bridge and a design drawing of a highway truss bridge for which calculations are made in course 175. Preparation required: 173. First term (4).

177. Hydraulic Engineering and Design. Three recitations and one drawing-room exercise a week are devoted to systems of water supply, including purification systems, reservoirs, pipe lines, pumping plants. The design of a water supply distribution system. The measurement of flow in open channels by means of tubes and meters. Water power. Irrigation. Preparation required: 171. First term (4).

178. Railroads. The construction of the roadbed; including ballast, crossties, rails, switches, culverts, and other details. Maintenance of way, and the elements of railroad operation. Visits of inspection, with written reports. Lectures on the economics of railroad location; the arrangement of yards, stations and terminals, train resistance, the application of electricity to the operation of railroads. Preparation required: 174. First term (2).

179. Geodetic Surveying. Recitations, calculations, field work. Precise leveling. Adjustment of instruments with investigation of their systematic errors. Elements of least squares and their application to the adjustment of triangulations. Field work in triangulation, in determination of azimuth, and with the plane table. Preparation required: 174. First term (3).

180. Mill Buildings. Design of roof trusses and three-hinged arches. Mill building construction. Preparation required: 173. First term (2).

181. Bridges and Dams. Higher structures, including continuous, draw, cantilever, and suspension bridges, also metallic arches. The theory and design of masonry walls, dams, and arches. Theory of deflections and applications to statically indeterminate structures. Preparation required: 175. Second term (4).

182. Sanitary Engineering. Systems of sewerage and methods of sewage treatment and disposal. The design of a sewerage system. House drainage. Preparation required: 177. Second term (3).

183. Reinforced Concrete. The manufacture, properties, and testing of hydraulic cement, mortar, and concrete. Each student makes all the standard tests on cement and on reinforced concrete beams and columns in the Fritz Engineering Laboratory. Reinforced concrete buildings, arches, and other structures; theory of reinforced concrete. Preparation required: 175. Second term (4).

184. Contracts and Specifications. Lectures on the essentials of contracts and specifications for engineering structures. Second term (2).

185. Ship Construction and Ocean Transportation. Design and construction of steel merchant ships. Hull construction. Terminal facilities, including steamship piers, railroad connections, dry docks. Ocean trade routes and ship canals. Ocean freight rates and terminal charges. Second term (2).

186. Reinforced Concrete. An abridgement of No. 183 for students in Ship Construction and Marine Transportation.

SUMMER SCHOOL IN CIVIL ENGINEERING

164. Land and Topographic Surveying. Exercises in Land Surveying and Topographic Surveying, designed primarily for students of the University, but open to all persons prepared to take them, are given in the summer vacation. In 1920, this work begins at 8 a.m., on June 16, and ends on July 12. Students in Civil Engineering, Mining Engineering and in Ship Construction and Marine Transportation are required to take this work at the end of their Freshman year. The fee for other persons is $20.00.

MECHANICAL ENGINEERING

PROFESSOR LARKIN, PROFESSOR DE SCHWEINITZ,
PROFESSOR KLEIN, ASSOCIATE PROFESSOR BUTTERFIELD,
ASSISTANT PROFESSOR BEAMENSDERFER,
MR. QUAST, MR. BONIS

200. DRAWING AND ELEMENTS OF MACHINE DESIGN. Orthographic, isometric and oblique projections, intersections and developments. Sketches and working drawings of machine pieces, tracings, details of screw-fastenings, keys and other fastenings. Students taking this course are required to take Course 169, Elementary Mechanics of Materials. Text-book: French's *Engineering Drawing*. First term (3).

201. CONSTRUCTIVE ELEMENTS OF MACHINERY. Visits of inspection. Examination and sketching of machine parts and machinery. A classified and numbered list of some three hundred and sixty items is given to each student, who inspects and studies them under the guidance of an instructor. The class is divided into sections, which are separately taken into shops by the instructor, who then indicates the pieces that are to be examined and gives all necessary explanations. In addition a score of machines of all sorts are taken apart and again put together by this class. This work is accomplished by Constructive Elements of Electrical Apparatus, No. 350. Summer term four weeks, beginning June 16, 1920.

202. ELEMENTS OF MACHINE DESIGN. Calculation of the dimensions of elementary machine parts such as spur-, bevel- and worm-gears, pulleys, shafting, couplings, bearings, connecting rods, etc., from the forces acting upon or transmitted by such machine parts. Working drawings of these pieces. Text-book: Leutwiler's *Elements of Machine Design*. Preparation required: 169 and 200. First or second term (3).

203. BOILERS. Description of various types, and details of construction, staying, setting, etc.; strength of the structure; accessories; fuels and furnaces; operation; wear and tear; visits of inspection to a boiler shop and to a boiler plant. Text-book: Peabody and Miller's *Steam Boilers*. First term (1).

204. STEAM ENGINES. Elementary Thermodynamics, theory of the ideal heat engine, properties of steam and efficiency of the steam engine. Mechanics of the engine, steam pressures, inertia resistances, turning force diagrams, etc Valve gears, valve dia-

grams applied to slide valves, shaft governors, and link motion. The steam engine indicator and study of diagrams. Outline of the study of economy, compounding, etc. The descriptive work is supplemented by shop visits. The solution of many graphical and numerical problems is required. Text-book: Heck's *Steam Engine.* Second term (4).

205. Heat Engines. Short course for students in courses other than Mechanical Engineering, covers Steam Engines, Steam Turbines, Internal Combustion Engines and Boiler Plants. Text-books: Hirshfeld and Ulbricht's *Steam-Power* and *Gas-Power.* First term (3).

206. Heat Engines. Work of 205 completed. Second term (3).

207. Steam and Gas Engines. A combination of courses 205 and 206 for students in the Chemical Engineering course. Second term (4).

208. Mechanical Technology. Each student is required to give a full written description of the various processes, operations, and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings and finished pieces, which are under construction in the shops at the time. The student's work is personally directed by an instructor, who accompanies him in each shop, giving necessary explanations, and tests the extent and accuracy of his knowledge. Summer term, four weeks, beginning June 16, 1920.

209. Graphic Statics of Mechanisms. Graphical determination of the forces acting on all the various pieces constituting a machine, covering a great variety of machines. Drawing of these machine, covering a great variety of machines. Drawings of these are given to the students. Frictional and inertia resistances are considered and the efficiencies of mechanisms are determined. First or second term (2).

210. Engineering Laboratory. Use and calibration of apparatus for measuring weight, volume, pressure, temperature, speed, etc., for engineering purposes. First term (2).

211. Engineering Laboratory. Work of 210 continued. Indicator practice on engines in the laboratory and in factories and power plants in the neighborhood; complete working up of indicator diagrams from simple and compound engines, air compressors, etc. Second term (1).

212. Machinery of Transmission. *Machinery of Transmission,* Weisbach-Herrmann series: Vol. III, Part I, Section 1. This

treats of the Mechanics of Machine Parts and determines their dimensions from considerations of strength and durability. The introduction is also studied for its analytical presentation of the subject of acceleration. First term (3).

213. Summer School in Engineering Laboratory. Simple tests with steam; steam calorimeters, injectors, flow of steam, performance of steam-traps, etc.; tests of small steam pumps, of a steam turbine, of engine performance; of hot-air and gas engines, and of an air compressor. Boiler management and testing. Dynamometer work, belt testing, friction and lubrication. Summer term, four weeks, beginning June 16, 1920.

214. Thermodynamics. Proof of the fundamental laws; equations of condition for air and superheated steam; the relations between pressure, volume, temperature, work and heat for special changes of state. Establishment of the fundamental equations of thermodynamics and their adaptation to gases, saturated and superheated vapors, and technical problems connected therewith. Text-book: Zeuner's *Technical Thermodynamics.* First term (5).

215. Kinematics of Machinery. This treats of the constrained motion peculiar to machinery and of the nature and equivalence of mechanisms. As here pursued it consists of a few lectures accompanied by a large amount of work in the drafting room. The work is expended on the construction of centrodes, on inversions and skeletons of mechanisms and also on the preparation of displacement, velocity and acceleration diagrams for a great variety of machines. This is followed by much practice in mass and force reductions, the latter including all forms of inertia resistance and external forces. Text-book: A. W. Klein's *Kinematics of Machinery.* Second term (4).

216. Advanced Machine Design. This covers the design of machines in general; especial attention is given to the calculation and designing of the various parts for strength, stiffness and other requirements. The problems cover such machinery as cranes, hoists, pumps, machine tools, hydraulic machinery, etc. First term (4).

217. Engineering Laboratory. Work of 211 and 213 continued. Tests of boilers, of power plants and of pumping stations in the neighborhood. Advanced work along the lines of 214. First term (1).

218. Engineering Laboratory. A shorter course, selected and condensed from 210, 211, 213, 217, 219 and 222, especially in steam

engineering, for students in Metallurgical and Mining and Electrical Engineering. First term (1).

219. Engineering Laboratory. Work of 218 completed, along same lines. Second term (1).

220. Advanced Machine Design. This is a continuation of course 216, being more specialized. Second term (4).

221. Mechanics of Machinery. This covers the principles involved in the design and construction of machinery such as hoisting-, pumping-, and air-machinery, locomotives, etc. Second term (3).

222. Engineering Laboratory. Work of 217 carried forward, along same lines. Analysis of flue gases; complete tests of the power plants of the vicinity. Second term (1).

223. Gas Engines. The Mechanics, Thermodynamics, Thermo-Chemistry, Construction, and Tests of the Gas Engine. Text-book and reference book: Streeter's *Internal Combustion Engines.* First term (3).

224. Steam Turbines. The Mechanics, Thermodynamics, Construction and Experimental Results of Stationary and Marine Steam Turbines. Text-book: Moyer's *Steam Turbines.* Second term (5).

225. Mechanical Engineering. Under this general head one or two of the following courses is given, viz., plant engineering, refrigeration, aeronautics, marine engines, etc. Second term (3).

226. Heat Engineering. The laws of gases and the gas cycles; the properties or steam and other vapors, the vapor cycles, entropy and the temperature-entropy diagram; a study of the theory of prime movers and the action of steam in engines and turbines; the use of the steam tables, the Mollier and temperature entropy diagrams. For students in the Course in Ship Construction and Marine Transportation. First term (3).

227. Marine Engines and Turbines. A detailed study of the multiple expansion reciprocating engine, the steam turbine and the Diesel engine. A study of the theory, economy and design of these three prime movers is taken up in the class room supplemented by work in the drawing-room and laboratory. For students in the Course in Ship Construction and Marine Transportation. First term (4); laboratory (1).

228. Plant Engineering. A study of the organization and operation of industrial plants in the vicinity of the University.

The course extends throughout the last three terms of the curriculum in Mechanical Engineering and covers a study of plant transportation, conversion, fabrication, power, and accessories. The course consists of lectures, laboratory work, shop visits, and reports in the form of Mechanical Engineering Seminary. Preparation required, Course 210. Second term (1). Effective second term, 1920-21.

METALLURGY

PROFESSOR RICHARDS,

ASSISTANT PROFESSOR ROUSH, MR. BUTTS, MR. DAWSON

244. INTRODUCTORY METALLURGY. A course of lectures on the history of the metals, details of the distribution of their ores and the geographical distribution and conditions of their production; their present economic and mechanical importance; a general study of their chemical and physical properties, touching particularly on their thermophysical and thermochemical relations. When possible to arrange, visits are made to metallurgical plants, to acquaint the student with the general features of metallurgical apparatus, their appearances and their working. First term (2).

245. GENERAL METALLURGY. Metallurgical processes. Principles of combustion. Applications of thermo-chemistry. Measurements of high temperatures. Fuels, natural and artificial, solid, liquid and gaseous. Fluxing. Refractory materials. Classification of furnaces. Artificial draft and blast. Electric furnaces. Reference books: Hoffman's *General Metallurgy*, Second Edition; Fulton's *Principles of Metallurgy*. Second term (2).

246. METALLURGY OF IRON. Chemical and physical properties of iron. Iron ores. Preparation of ores. The blast furnace. The mixer. Remelting. Refining. Puddling. The Bessemer process. The open hearth process. Duplex process. Cementation. Manufacture of crucible steel. Electric steel. Alloy steels. Direct processes. Casting, forging and heat treatment. Reference books: Ledebur's *Eisenhüttenkunde*. Stoughton's *Metallurgy of Iron and Steel*. Second term (2).

247. METALLURGICAL PROBLEMS. A course of problems embodying the use of the physical, chemical and mechanical principles as the basis of practical metallurgy. The data are taken from actual practice, and the results have an important bearing in the under-

standing of metallurgical processes. Reference: Richards' *Metallurgical Calculations*, Parts I and II. Second term (1).

248. General Metallurgy. Shorter course. Reference books: Fulton's *Principles of Metallurgy*, Hofman's *General Metallurgy*. First term (1) or second term (1).

249. Metallurgy of Iron, Steel and Other Metals. A shorter course. Reference books: Stoughton's *Metallurgy of Iron and Steel*. Gowland's *Metallurgy of Non-Ferrous Metals*. First term (1) or second term (1).

250. Metallurgical Problems. A course of problems embodying the use of physical, chemical and mechanical principles utilized in practical metallurgy, particular attention being paid to the needs of the civil, mechanical and electrical engineer. Richards' *Metallurgical Calculations*, Parts I and II. First term (1) or second term (1).

Courses 248, 249 and 250 are an abridgment of Courses 245, 246, 247 and 251, for students of Civil, Mechanical and Electrical Engineering, Ship Construction and Marine Transportation.

251. Metallurgy of Copper, Lead, Silver, Gold, Zinc, Tin, Mercury, Nickel, Aluminium, etc. Copper: Chemical and physical properties. Ores. Smelting sulphide ores. The Bessemer process. Treatment of oxide ores. Wet process. Electrolytic processes. Lead: Chemical and physical properties. Ores. Smelting processes. Condensation of lead fume. Refining and desilverization of base bullion. Silver: Chemical and physical properties. Ores. Smelting with lead. Amalgamation. Leaching processes. Gold: Chemical and physical properties. Ores. Gold washing. Gold milling. Chlorination. The cyanide process. Parting gold and silver. Zinc: Chemical and physical properties. Ores. Belgian and Silesian processes for the manufacture of spelter. Manufacture of zinc oxide. Electrolytic processes. Mercury: Chemical and physical properties. Ores. Processes of extraction. Aluminium: Chemical and physical properties. Ores. Extraction by electrolysis. Tin, Nickel, Platinum, Antimony, etc.: Chemical and physical properties; Ores; Alloys; Processes of Extraction. Reference books: Schnabel's *Handbook of Metallurgy*, Gowland's *Metallurgy of the Non-Ferrous Metals*, Hofman's *Metallurgy of Copper*, Hofman's *Lead*, Collins' *Silver*, Rose's *Gold*, Ingall's *Zinc*, Richards' *Aluminium*, Louis' *Metallurgy of Tin*, Wang's *Antimony*. For students of Mining Engineering. First term (4).

252. Metallurgical Problems. A course of problems concerned

with the principles utilized in the metallurgy of the non-ferrous metals. Reference: Richards' *Metallurgical Calculations*, Part III. First term (1).

253. Electrochemistry. Lectures discussing the phenomena of electrolysis and the various theories proposed to account for them. Special consideration of secondary reactions, and also of the quantitative relations between electrical and chemical energy, and their mutual convertibility. Reference books: Le Blanc's *Text-book of Electrochemistry.* Allmand's *Applied Electrochemistry.* First term (1).

254. Electrometallurgy. Lectures discussing the practical application of electricity to metallurgical processes. Electrolytic and electric furnace plants and practice. Reference books: Borcher's *Electric Smelting and Refining.* Neuberger's *Handbuch der Praktischen Elektrometallurgie.* Second term (1).

255. Electrochemical Laboratory. Quantitative relations in the deposition of metals by electrolysis. Experimental study of the conditions controlling the nature of electrolytic deposits. Electrolysis of fused salts. Cathodic and anodic reactions. Fee, $5; deposit, $5. First term (1).

256. Metallurgical Laboratory. Calibration and use of instruments employed in metallurgical investigations, pyrometers, calorimeters, etc. Determination of specific heats, latent heats of fusion and vaporization, vapor tensions, heats of combustion, heats of chemical combination and reaction. Heat conduction and radiation. Determination of efficiencies of furnaces. Experiments with electrochemical processes, electric furnaces, etc. Fee, $10. Second term (2).

257. Metallography. The study of Metals and Alloys: their physical, chemical and microscopic properties together with deductions drawn therefrom. The influence of thermal and mechanical treatment on physical properties and structure. Lectures and laboratory work. Fee $10; deposit, $10. Reference books: Gulliver's *Metallic Alloys,* Sauveur's *Metallography and Heat Treatment of Iron and Steel.* First term (2).

258. Metallurgical Design. The application and extension of the principles involved in Courses 247 and 252 to the design of metallurgical apparatus and machinery. Second term (2).

259. Metallurgical French or German. Reading of technical journals or books with the staff of the Department. First term (1).

260. Seminary. A conference hour of the staff of the Department with students, to discuss current metallurgical processes and problems, and thesis work, involving some reading of current literature and other preparation on the part of the students. First term (1). Second term (1).

261. Thesis for Degree. Every student in Metallurgy is required to present a thesis on some topic which requires original literary and other work, such as observations, calculations, or experimental tests when practicable.

For summer schools, see courses 350 and 413, also statement on page 131.

GEOLOGY

PROFESSOR MILLER, ASSISTANT PROFESSOR TURNER, MR. FRETZ

266. Mineralogy. The principles of crystallography with practice in the determination of forms on models and crystals. The physical properties, origin, occurrence, association, and alteration of minerals. A study of about one hundred and fifty of the common mineral species and varieties, particularly the rock-forming minerals, with practice in identification based on association and physical properties. First term (4).

(A deposit of $5 is required from each student taking course 266, to cover damages to collections and instruments and the value of supplies furnished him. In case the damage consists only of ordinary wear and tear the amount retained to cover it is about $3 for each student.)

267. Blowpipe Analysis. A course in qualitative blowpipe analysis and special chemical tests in which the chemical and physical behavior of all of the common chemical elements and their compounds under various conditions is noted. The object of the course is to acquaint the student with methods of rapid qualitative testing as a means of identifying minerals and chemical compounds with the aid of the blowpipe. Fee, $4. First term (2).

268. General Geology. A course in dynamic, structural, and historical geology. The text-book is supplemented by illustrated lectures in which the relation of geology to engineering problems is discussed. The different geologic periods and their characteristic types of life are studied. The principles of organic evolution as shown in the development of new forms in the successive

periods are treated; also a brief review of the geology of the North American continent and the physical changes which it has undergone during its development. Second term (2).

269. Geological Laboratory and Field Trips. During the winter months most of the time is devoted to the study of rocks. This course is designed primarily to enable students to determine and classify the various types of rocks without the use of the microscope. The principles of rock classification are discussed in a series of lectures which are supplemented by laboratory practice with a petrologic collection comprising rocks gathered from all parts of the world. Attention is also given to the examination of the varieties of rocks used for constructional purposes with discussions of the factors which render them desirable. A series of lectures is given on primary and secondary rock structures, supplemented by laboratory work on the interpretation and construction of topographic and geologic maps and sections. During the spring months, field trips are taken weekly to nearby localities to study rock structures and deposits of economic importance. The region furnishes excellent examples of varied structures and contains numerous quarries where slate, cement rock, limestone, sandstone, gneiss, and serpentine are obtained, all of which are visited by the classes. On such field trips, special attention is given to the methods of geologic mapping. Second term (3), (2) or (1).

(A fee of $1 is required of each student taking Course 269 to cover damage to collections and the value of supplies furnished.)

270. Economic Geology. A study of the origin, modes of occurrence, properties, sources, production, and uses of the nonmetallic mineral products. Comprehensive reports on various products comprise a portion of the work. Preparation required: 266, 268 and 269. First term (2).

271. Economic Geology. A study of the metallic mineral products. Causes of the formation of cavities in rocks, their relation to metalliferous deposits; discussion of the theories of ore-deposition; the structure, geological horizon, and geographic distribution of the prinicipal metallic economic deposits of the United States. Recitations, illustrated lectures, field trips, and laboratory work. For the purpose of studying ore occurence, visits are made to the zinc mines of Franklin Furnace, N. J., and Friedensville, Pa., the magnetite mines of Dover, N. J., and Cornwall, Pa., the limonite mines of Ironton, Pa., and the anthracite

coal mines. Each student is required to prepare a series of maps illustrating the location, production, chemistry, and geology of the economic products of the United States. Preparation required: 266, 268 and 269. Second term (4).

272. Paleontology. An elementary course in paleontology in which the animal life of the past is considered both from the biological and geological viewpoints. Theories of origin and evolution of life are outlined, and principles of stratigraphy and paleontology are discussed. Index fossils of the successive geologic periods are studied in the laboratory. Preparation required: 268 and 269. Second term (3).

273. Geology of North America. The geological age and geographical distribution of the rocks of which North America is composed; the structure and history of its mountain ranges; the history of its geological development and origin; reviews of the great surveys that have been made. Lectures and laboratory work. Preparation required: 268 and 269. Second term (3).

274. Physiography. The cosmic relations of the earth; the classification of land forms; the study of their origin, growth, and decay and the factors governing their development. Topographic and geologic maps are studied. The relation of topography to geologic structure is shown. The response of man and other organic life to an inorganic environment with special reference to the influence of physiography upon the economic development of countries. Brief study of weather and climate. Second term (2).

275. Field Geology. Geological maps—their use and the methods by which they are constructed. Practice in the actual working out of surface geology. Problems in plotting geology on topographic maps; each student is assigned a definite area and required to make a geological map of it with structure sections. He also collects a full set of specimens to illustrate the geology. The first part of the course is devoted exclusively to field work and the notes then taken are worked up in the laboratory when the weather prevents further out-door work. A fee of $1 is charged to students taking this course. Preparation required: 268 and 269. First term (3).

276. Petrography. The optical properties of minerals and their study with the petrographic microscope. Petrography of the more important igneous rocks. Lectures, recitations, and laboratory

work. A laboratory fee of $3 is charged all students taking this course. Preparation required: 266 and 325. First term (2).

277. PHYSIOGRAPHY. A study of topographic forms and the processes that have produced them; the weather and climate; and the influence of physical conditions upon the development of countries. First term (3).

278. PHYSOGRAPHY. A continuation of Course 277. Recitations, lectures, laboratory work, and field trips. In this work a study is made of the physiographic regions of North America and Europe. The student becomes familiar with topographic maps and the preparation of weather and climate charts. Emphasis is placed on the effect that physiographic conditions have in determining the commercial and industrial importance of nations. Second term (3).

279. MINING AND GEOLOGIC LAW. A study of the legal matters that confront a mining geologist. The law in regard to underground waters and mineral products is studied and abstracts of important cases, accompanied by drawings showing the geologic conditions upon which the decisions were made, are prepared. First term (1).

280. STRUCTURAL GEOLOGY. The study of special features of structural geology in the field and laboratory. First term (1).

281. GEOLOGIC METHODS. The study of methods employed by the geologist in the various lines of geologic investigation. In this study the student is made familiar with the methods employed by the United States Geological Survey and by the mining companies that employ geologists. Special attention is given to the problems that confront an economic geologist in the investigation of coal lands, oil properties, metal mines, etc. Second term (3).

BIOLOGY

PROFESSOR HALL, MR. REX

290. BOTANY. An elementary course treating of the structure and classification of plants. Lectures, laboratory work, and reference to text-books. Preparation advantageous: 292. Second term (2).

291. FORESTRY. Lectures, recitations and laboratory work. The lectures cover a brief introduction to botany. This is followed by lectures on dendrology and text-book work on forestry. The laboratory work is devoted mainly to dendrology and the character-

istics of the wood of important timber species. Field trips during the autumn enable the student to become familiar with the trees of the region. First term (3).

Careful consideration has been given by friends of the University and by the Board of Trustees to the matter of Forestry in connection with the conservation of our natural resources. It does not appear to the Trustees that at the present time the call for professional foresters is such as to justify the establishment of a School of Forestry at the University, but it seems that the question is of such great and growing importance that the University should do its part toward calling the attention not only of its students but of the public in the section of country reached by the influence of the University to the need of a better knowledge of the principles involved. To this end, courses of lectures have been instituted to which the public is invited and special instruction is given in Forestry in certain of the courses.

In furtherance and support of the cause of Forestry the University has offered free tuition scholarships to graduates of the Pennsylvania State School of Forestry at Mont Alto, to pursue, as special students at this University, courses supplementary and cognate to their studies at Mont Alto.

292. Biology. Lectures, recitations, and laboratory work. The lectures discuss the following topics: (*a*) fundamental conceptions; life, protoplasm, the cell, etc.; (*b*) the structure, development, relationships, habits, and geographic distribution of animals; (*c*) the more important biological theories; variation, heredity, evolution, etc. In the laboratory, types of the various phyla are dissected and drawings made. First term (3).

293. Comparative Anatomy of Vertebrates. Lectures on the comparative anatomy of vertebrates, with a more extended discussion of biological theories. The laboratory work consists of the dissection of types of the several vertebrate classes. Preparation required: 292. Second term (3).

294. Vertebrate Embryology. Lectures, reading and laboratory work. By the study of living, preserved, and sectioned material, the successive stages of cleavage, gastrulation, and the formation of organs are demonstrated. Preparation required: 293. First term (3).

295. Sanitary Biology. Lectures, recitations, assigned reading and laboratory work. Study of bacteria; microscopical appear-

ance, methods of staining, plate and tube culture, etc. The quantitative and qualitative bacteriological and microscopical examination of water. Second term (3).

296. Bacteriology. Recitations and laboratory work. After the general study of bacteria, special attention is paid, in this course, to those forms which are economically important, such as those of water, foods, dairy products, soils, etc. Preparation advantageous: 290 or 292. First term (2).

297. Advanced Bacteriology. Lectures and recitations on the study of disease, immunity and sanitation. Laboratory work on the determination of species, with a special study of the pathogenic bacteria. Opportunity is given for the independent study of special problems in practical hygiene. Preparation required: 295 or 296. Second term (2). (Not offered in 1920-21.)

298. Physiology. A course in normal physiology, hygiene and sanitation. Its object is to give that knowledge of the body and its functions which all should have. A text book is chosen which emphasizes the application of such knowledge to personal hygiene and public sanitation. While some previous training in biology is of great value, it is not an absolute necessity. Second term (2).

(A fee of $3 is required in courses 292, 295, 296, and 297, to cover the cost of material and breakage.)

HYGIENE

DR. ESTES

299. Hygiene. Lectures intended to teach the students some idea of the importance and the methods of personal hygiene and sanitary laws will be given during the course. It is also intended to suggest to young men who may become engineers, miners, and explorers the importance of and how to take proper measures for the sanitary comfort and personal well-being of men who may, in after life, be under their control and leadership.

MINING ENGINEERING

PROFESSOR ECKFELDT, ASSISTANT PROFESSOR BARTLETT, MR. BENDER

300. MECHANICAL DRAWING. The use of instruments. Lettering and tracing. Isometric drawing. Sketches and working drawings of simple machine parts. Blue printing. DESCRIPTIVE GEOMETRY. Projections, intersections, and developments of cylinders, prisms, cones, etc. Application to graphical solution of mining problems. First term (3); second term (3).

301. MINING ENGINEERING. PROSPECTING. Modes of occurrence of minerals. Uses of geology. Prospecting for placers, veins and beds. Magnetic prospecting. Drilling, sampling. Valuation of property. Location of claims. Patenting mining ground. BORING. Uses of bore-holes. Methods; by percussion and rotation. Special methods. Shaft sinking by boring. Survey of bore-holes. EXPLOITATION. Location of plant. Rock drilling; tools and machines. Explosives; blasting; safety regulations. Shaft and slope sinking; tunneling. Supporting excavations by timber, metal, masonry, or concrete. Systems of mining underground and at the surface. HAULAGE. Surface and underground methods. Motors and cars; wire rope, aerial tramways. Loading and unloading, storage of minerals. Transportation of workmen. Signaling. First term (4).

302. ORE DRESSING. General principles and physical properties upon which the recovery of minerals or metals from ores are based, followed by detailed study of machines and apparatus used in modern practice for coarse and fine crushing; classifying and preparation for concentration; various methods of concentration, including gravity and magnetic methods, oil flotation, etc.

Application of above methods to various ores; mill schemes or flowsheets. Study of procedure followed for treatment of ores and coal in typical modern concentrating plants.

Mill location, construction, arrangement of machinery, operation, and costs. Visits to mills and anthracite breakers.

ORE DRESSING LABORATORY. Experimental work and tests on ores, giving practical application of principles and processes covered. A well equipped modern laboratory gives opportunity for individual as well as class operation of the most approved machinery for the preparation of ores. Deposit, $10. First term (3).

303. MINING ENGINEERING. HOISTING. Motors, ropes, attachments, receptacles. Safety appliances. Systems of hoisting. DRAINAGE. Surface water; prevention of access. Mine dams. Tunnel drainage. Mechanical drainage; water hoisting; pumping. Classes of pumps. VENTILATION. Atmosphere of mines. Pollution of air. Natural and mechanical methods of ventilation; systems. Types and efficiencies of ventilating machines. Instruments for testing air. Ventilation laws. LIGHTING. Methods employed. Safety lamps; electric lighting. Safety regulations. FIRST AID. Accidents; classes, causes. Means of prevention. Rescue work. Hygiene of mines; rules and laws. First Aid to injured. RAILROAD CONSTRUCTION. Earthwork, trackwork, trestles, bridges, railroad structures, water tanks, yards. Second term (4).

304. MINE SURVEYING. Instruments. Forms of notes. Outside work. Determination of meridian. Inside work. Connecting outside and inside work through shafts, slopes, or tunnels. Calculation of notes; mapping. RAILROAD SURVEYING. Preliminary and location methods; theory of curves, turnouts, etc. Care of maps. Detection of errors. Special problems. Fee, $1. Summer term at the end of Junior year, four weeks, beginning June 16, 1920.

305. MINING ENGINEERING. CONSTRUCTION MATERIALS. The use of stone, brick, concrete, metal and wood for foundations, piling, dams, reservoirs, retaining walls, mine buildings, railroads, trestles, tipples, ore bins and docks. MINE ADMINISTRATION. Organization, employment of labor, management, mine accounts, principles of mining. First term (3).

306. OIL AND GAS TECHNOLOGY. Origin and distribution of petroleum and natural gas. General survey of the geological conditions surrounding their accumulation. Oil shales. Prospecting and mapping. Location of wells. Drilling; pumping. Special methods. Storage. Pipe lines. Tank cars. Second term (2).

307. MINING DESIGN. The design of parts of mining plant to meet given conditions, with detailed working drawings, accompanied by estimates of material and costs. Second term (3).

308. PROSPECTING. Surface indications of minerals, including oil, gas and water. Geological interpretation of strata and outcrops. Prospecting on surface and underground. Boring; magnetic prospecting. Mapping. Sampling and valuation of prospects. Locating and patenting claims. First term (2).

PHYSICS

PROFESSOR MAC NUTT,
ASSOCIATE PROFESSOR CHARLES, ASSISTANT PROFESSOR WILY,
ASSISTANT PROFESSOR FRY, ASSISTANT PROFESSOR FRAIM,
MR. MARTIN, MR. ZINSZER

320. Elementary Mechanics. Statics. Lecture demonstrations and recitations. First term (3).

321. Elementary Mechanics. Dynamics. Heat. Lecture demonstrations and recitations. Second term (3).

322. Physical Measurements. Laboratory and lectures. Second term (1).

323. Elementary Physics. Electricity and Magnetism. Lecture demonstrations and recitations. First term (3).

324. Physical Laboratory. Mechanics, Heat and Electricity. Pre-requisite, Course 322. First term (1).

325. Elementary Physics. Light and Sound. Lecture demonstrations and recitations. Second term (3).

326. Physical Laboratory. Electricity, Magnetism, Light and Sound. Pre-requisites, Courses 322, 323, 324. Second term (1).

327. Elementary Physics. A brief general course. Lecture demonstrations, recitations and laboratory. First term (3). Second term (3).

328. Advanced Theory of Electricity and Magnetism. Lectures and recitations. Ferro-magnetism, electro-magnetism, induced electromotive force and inductance, magnetic properties of iron, electric charge and the condenser, electric field, potential, electric oscillations and waves, electron theory, electrolysis. Pre-requisites, Differential and Integral Calculus and Course 323. First term (2).

329. Electrical Laboratory. Precise measurements. Pre-requisites, Courses 322, 323, 324, 326. First term (1).

330. Electrical Laboratory. Precise measurements. (Continuation of 329.) Second term (1).

331. Electrical Laboratory. Advanced experimental studies and tests. (Continuation of 330.) First term (1).

332. Theoretical Physics. Elective courses are offered in the Theory of Heat, in the Theory of Electricity and Magnetism, and

in the Theory of Optics. Arrangements as to topic and as to time to be devoted to it are made for each group of students who elect Theoretical Physics. First and second terms (3) to (5).

333. Physical Research. Special advanced students may elect to pursue experimental investigations in Physics. Arrangements as to topic and as to time to be devoted to it are made for each individual student. First or second term (2) to (4).

334. Photometry and Illumination. Lectures and recitations. Illuminant Standards, Measurements of Light and of Illumination, Laboratory Methods and Devices, Commercial Methods and Experiments, Comparison of Illuminants and Illuminating Devices, Practical Installations. First term (1).

335. General Physics. A course intended primarily for students taking pre-medical studies. Pre-requisite, Course 327. First term (3); second term (3).

A fee of $6 is required in connection with Courses 322, 324, 326, 329, 330, 331, and 333.

ELECTRICAL ENGINEERING

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT, ASSISTANT PROFESSOR SCHEALER, ASSISTANT PROFESSOR BEAVER, ASSISTANT PROFESSOR GRUBER, MR ESHBACH

350. Constructive Elements of Electrical Apparatus. Studies of electrical machinery and appliances with the object of familiarizing the student with principles of operation, structural details, and practical uses. The student is supplied with a complete printed outline of the work to be done containing full instructions and explanations. The work consists of three parts, as follows: (*a*) Illustrated lectures, (*b*) inspection and sketching of electrical machines and apparatus, and (*c*) visits of inspection to neighboring electric light and power plants. Written reports are required on each day's work. Fee, $3. This work is accompanied by Constructive Elements of Machinery, No. 201. Summer term, four weeks, beginning June 16, 1920.

351. Electrical Distribution. Systems of direct current distribution; wiring formulas and applications; installation of electrical machinery and apparatus; interior wiring, overhead and underground construction; rules and regulations of the National Board of Fire Underwriters. Preparation required: 350. First term (2).

352. Dynamos and Motors. Review of principles of electricity and magnetism with special reference to their application to the dynamo. The construction, operation and control of direct current machinery; practical operation and management of dynamo machines; station equipment; cost of electrical energy; electromagnets, magnetism of iron; characteristic curves, armature windings. Illustrative problems. Preparation required: 322, 351. Second term (3).

353. Dynamo Laboratory. Introductory course supplementing the class work of 352. Experimental studies and tests of direct current generators, motors, and appliances, for characteristics, regulation, efficiency, insulation, etc. Fee, $6. Preparation required: 322, 351. Second term (1).

354. Dynamos and Motors. This is an abbreviated course adapted to those students who do not continue this subject in the following year. It treats of the principles and practice of direct current engineering, and includes: the elementary theory, construction, operation and control of direct current generators and motors, electromagnets, solenoids, automatic starters and controllers, station equipment, storage batteries. Illustrative problems. Preparation required: 323, 324. First term (2).

355. Dynamo Laboratory. Introductory course supplementing the class work of 354. Experimental studies and tests of direct current generators and motors for characteristics, regulation, efficiency, etc. Fee, $6. Preparation required: 323. First and second terms (1).

356. Dynamo Laboratory. Continuation of 355 and supplementing the class work of 362 or 379. Advanced testing of direct current machines; practice is given in operating and testing alternating current apparatus. Fee, $6. Preparation required: 355, 354. Second term (1).

357. Theory of Alternating Currents. The elementary principles of alternating currents. Lectures, recitations and problem work. Preparation required: 352, 326. First term (3).

358. Dynamo Laboratory. Continuation of 353. Advanced testing of direct current machines. Fee, $6. Preparation required: 352, 353. First term (1).

359. Theory of Alternating Currents. Continuation of 357. Advanced theoretical studies of alternators, synchronous motors, and synchronous converters. Preparation required: 357. Second term (2).

360. Electrical Engineering. Application of physical and mathematical principles to the analysis and solution of problems relating to direct and alternating current circuits and apparatus; transient phenomena, use of complex quantities; non-harmonic periodic wave forms. Preparation required: 328, 357. Second term (2).

361. Electrical Engineering. This course is particularly adapted to students who do not further specialize along electrical lines. It includes systems of generation, transformation, distribution and transmission of electrical energy by direct and alternating currents; the application of electric motors to various industries; overhead and underground construction; estimates and costs. Preparation required: 354, 355. Second term (2).

362. Dynamo Laboratory. Continuation of 358. Advanced testing of direct current machines. Alternating current testing begun. Fee, $6. Preparation required: 357, 358. Second term (1).

363. Alternating Current Machinery. Study of the structural details, characteristics and operation of alternators, alternating current motors, rotary converters, and transformers; application of vectors. Preparation required: 329, 359, 360. First term (4).

364. Dynamo Testing. Lectures on the methods of testing electrical machinery and apparatus, including direct current generators, motors, and motor generator sets. Special methods of testing large machines; commercial tests as carried out by the large manufacturing companies. Preparation required: 328, 357, 358. Second term (1).

365. Dynamo Testing. Continuation of 364. Lectures on testing of alternating current machinery and apparatus, including generators, motors, rotary converters, transformers, induction regulators, etc. Preparation required : 359, 364. First term (1).

366. Dynamo Laboratory. Advanced experimental studies and tests of direct and alternating current generators and motors, synchronous converters, transformers, and auxiliary apparatus; measurement of power in polyphase circuits. Fee, $12. Preparation required: 359, 360, 362. First term (3).

367. Electrical Design. Application of electric, magnetic and mechanical principles to the design of electromagnetic mechanisms, direct current generators and motors; predetermination of characteristics and performance; armature windings. Lectures, recitations, problems, drafting. Preparation required: 359, 360, 362. First term (3).

368. Electric Stations. Consideration of prime movers; generating machinery, discussion of types and operation; auxiliary machinery and transformers; storage batteries and their application; switch-boards, measuring and protective devices; design and arrangement; station characteristics; sub-stations; operation and management; visits to neighboring plants. Preparation required: 355 or 356, 360 or 361. First term (2).

369. Electrical Engineering Seminary. A weekly meeting is held in the department reading room for discussion of topics from the current journals of theoretical and applied electricity. Presentation of papers on assigned topics; new inventions and discoveries critically reviewed. Preparation required: 357, 360. First term (1).

370. Electrical Design. Continuation of 367. Application of electric, magnetic and mechanical principles to the design of alternating current machinery and apparatus; predetermination of characteristics and performance; armature windings. Lectures, recitations, problems, drafting. Preparation required: 363, 366, 367. Second term (2).

371. Electric Traction. The construction, equipment and operation of different types of electric railways. The application of electric traction under steam railroad conditions; the dynamics of electric train movements; predeterminations of speed-time curves and the power required for different types of runs. Choice of car equipment; cost of construction and of operation. Testing of railway systems. Visits of inspection to power plants are made and reports required. Preparation required: 363, 368. Second term (3).

372. Electric Power Transmission. The long distance transmission of power by electricity for use in lighting, traction, mining and manufacturing work. Comparison of electric transmission and other systems. The design, construction, maintenance and protection of lines; the effects of inductance and capacity on the operation of power systems; the generating plant and receiving systems. Preparation required: 357 or 363, 360 or 361, 363. Second term (3).

373. Electrical Engineering Seminary. Continuation of 369. Reports on thesis work are presented and discussed. Preparation required: 369. Second term (1).

374. Dynamo Laboratory. Continuation of 368. Advanced alternating current testing. Fee, $12. Preparation required: 363, 364, 366. Second term (2).

375. Alternating Currents. This course follows Course 354 and covers the principles and practice of alternating current engineering. It includes the theory of alternating currents with applications to alternating current generators, motors, transformers and other apparatus; systems of transmission and distribution; electric lighting. Preparation required: 354. First and second terms (2).

376. Inspection Report. During the vacation between the Junior and Senior years each student in Electrical Engineering is required to inspect some electric railway system, lighting or power plant, or other electrical installation, and prepare a written report thereon. A descriptive outline of the installation which the student proposes to inspect must be submitted to the Professor of Electrical Engineering before July 12th, and after approval the detailed report must be handed in before September 19th. These reports should contain such calculations, photographs, drawings and plots as each individual case may require.

377. Thesis. Until this year each candidate for the degree of Electrical Engineer was required to present a thesis upon a subject chosen by the candidate during the first term of the Senior year. At present the thesis is not required, but the candidate is allowed the choice between preparing a thesis and taking Course 378 in Electrical Communication. The work upon which the thesis is based is done during the second term. It consists in part of reading from references, and in part of independent work in theory, experimental research or designing. Reports of progress in thesis work are required from time to time during the term. Second term (3).

378. Electrical Communication. A survey of the methods of electrical communication, principles of various systems of wire telegraphy, wire telephony, radio telegraphy and telephony, radio laboratory measurements, radio practice of the U. S. Signal Corps. Preparation required: 357 or 375. Second term (3).

A fee of $6 for each term-hour (period) of dynamo laboratory work taken per term is required of each student.

For Summer Schools, see Courses 201, 350, 206, and 375, also statement on page 131.

CHEMISTRY

PROFESSOR ULLMANN, ASSOCIATE PROFESSOR BABASINIAN, ASSOCIATE PROFESSOR DIEFENDERFER, ASSISTANT PROFESSOR BECK, ASSISTANT PROFESSOR CHAMBERLIN, ASSISTANT PROFESSOR LONG, ASSISTANT PROFESSOR COBB, DR. DARBY, MR. EVERHART, MR. CARTER, MR. ANDERSON, MR. BUCKLEY, MR. BOYD, MR. SMULL, MR. WARD

390. Elementary Chemistry. Description of the non-metallic and metallic elements and their compounds. Lectures illustrated by experiments, diagrams, working drawings, and specimens from the museum. Note-books on the lectures required. Text-book: Kahlenberg's *Outlines of Chemistry*. First term (2).

391. Chemistry Laboratory. Experiments covering a systematic study of the chemical and physical properties of the more important elements and their compounds. Text-book: Long and Chamberlin's *Experimental General Chemistry*. First term (2).

392. Chemistry Laboratory. For B.A. students. Shorter course than course 391. First term (1).

393. Chemistry. This course is intended for those students who have passed the examination in Elementary Chemistry held on the first Saturday of the term. Text-book: Senter's *Inorganic Chemistry*. First term (2).

394. Chemistry. Continuation of 390 and 393. Second term (1).

395. Qualitative Analysis. Practical work in the qualitative laboratory, accompanied by lectures and recitations. Text-book: Treadwell's *Analytical Chemistry*. Vol. I. Second term (3).

396. Qualitative Analysis Conference. Special consideration of science underlying qualitative analysis. Second term (1).

397. Stoichiometry. Chemical problems and reactions. Text-book: Long and Salisbury's *Chemical Calculations*. Second term (1).

398. Chemical Philosophy. Lecture Course, with recitations. Theories of chemistry; physical and chemical methods of determining atomic and molecular weights, thermo-chemistry, dissociation, solutions, catalysis, electrolysis, radio-activity, non-metallic elements and their compounds. Prerequisite: courses 390 or 393, 391, 397. Text-book: Mellor's *Modern Inorganic Chemistry*. First term (3).

399. Advanced Chemistry. Lecture course, with recitations. Phase rule, solid solutions, colloid chemistry, metallic elements and their compounds. Prerequisite: Course 398. Text-book: Mellor's *Modern Inorganic Chemistry*. Second term (3).

400. QUANTITATIVE ANALYSIS. Practical work in the quantitative laboratory, accompanied by lectures and recitations. Acidimetry, alkalimetry, chlorimetry, and the determination and analysis of simple chemical compounds and ores. Text-book: Treadwell's *Analytical Chemistry*, Vol. II. First term (3).

401. QUANTITATIVE ANALYSIS. Shorter course. Practical work in the quantitative laboratory. Analysis of simple chemical compounds, ores and metallurgical products. First term (3).

402. QUANTITATIVE ANALYSIS CONFERENCE. Lecture and recitations concerning the laboratory work of Courses 400 and 401. First term (1).

403. QUANTITATIVE ANALYSIS. Continuation of Course 401. Second term (3).

404. QUANTITATIVE ANALYSIS. Continuation of Course 400. Analysis of minerals, ores, slags, alloys, electrolytic analysis, etc. Text-book: Treadwell's *Analytical Chemistry*, Vol. II. Second term (4).

405. QUANTITATIVE ANALYSIS CONFERENCE. Lectures and recitations concerning laboratory work of Courses 401 and 400. Second term (2) or (1).

406. QUANTITATIVE ANALYSIS. Continuation of Course 401. Ores and alloys, complete analysis of iron and steel; also gas analysis, mineral water analysis, etc. Text-books: Treadwell's *Analytical Chemistry*, Vol. II, Lord and Demorest's *Notes on Metallurgical Analysis*, Hempel's *Gas Analysis*. First term (2).

407. QUANTITATIVE ANALYSIS CONFERENCE. Discussions concerning the laboratory work of Course 406. First term (2).

408. ORGANIC CHEMISTRY. Lectures and recitations. Typical compounds of carbon, their classification, general relations, and methods of preparation of important compounds. Text-book: Bernthsen's *Organic Chemistry*, translated by Sudborough. First term (3).

409. ORGANIC CHEMISTRY. Laboratory work. Determinations of specific gravities, melting points, boiling points, vapor densities; qualitative and quantitative determinations of carbon, hydrogen, nitrogen, and the halogens. The preparation of pure organic compounds. Text-books: Gattermann-Schober's *Practical Methods of Organic Chemistry*, Levy's *Organisch-Chemische Präparate* First term (2).

410. Organic Chemistry. Continuation of Course 408. Lectures and recitations. Second term (4).

411. Organic Chemistry. Laboratory work. Continuation of Course 409. Practical methods of saturation, nitration, reduction, diazotisation, sulphonation, etc. Preparation of pure compounds. Study of the properties of dyes and other commercial products. Text-book: Gattermann-Schober's *Practical Methods of Organic Chemistry*, Levy's *Anleitung zur Darstellung organisch-chemischer Präparate*, Cohen's *Practical Organic Chemistry*. Second term (4), (3) or (2).

412. Industrial Chemistry. Engineering fundamentals, in cluding machinery and materials of chemical plants, transportation of gases, liquids and solids, grinding, pulverizing, screening, filtration, evaporation, distillation, etc. Laboratory work includes the application of these fundamentals, with reports on various problems of chemical engineering. First term (3).

413. Assaying. Lectures and laboratory practice in the furnace assay of the ores of lead, tin, gold, silver and of gold and silver bullion. Cyanidization. Calculations for slag and slag mixtures. Text-book: Lodge's *Notes on Assaying*. Summer term: four weeks.

414. Assaying and Industrial Mineralogy. This covers much of the ground of Course 413. In addition there is instruction and laboratory work in Industrial Mineralogy, embracing about 75 minerals and rocks. It is intended primarily for students in Chemical Engineering. Summer term, five weeks, beginning June 16, 1920.

415. Industrial Chemistry. Continuation of 412. Lectures, problems and inspection trips on chemical processes and industries. Second term (3).

416. Industrial Analysis. Analysis of commercial products. Laboratory work. Text-book: Allen's *Commercial Organic Chemistry*. Second term (3).

417. Industrial Analysis Conference. Lectures concerning the laboratory work of Course 413. Second term (1).

418. Sanitary Chemistry Laboratory. Qualitative and quantitative examination of drinking water and food-stuffs. Second term (2).

419. Physical Chemistry. Lectures and recitations. Text-book: Lewis' *A System of Physical Chemistry*. First term (3).

420. Physical Chemistry Laboratory. Physico-chemical measurements. Text-book: Findlay's *Practical Physical Chemistry*. First term (1).

421. Physical Chemistry. Continuation of 419. Second term (2).

422. Physical Chemistry Laboratory. Continuation of 419. Second term (1).

423. Research Chemistry Laboratory. Investigation approved by the Professor of Chemistry of some novel problem, involving exhaustive laboratory and library study. Second term (2).

424. History of Chemistry. Chronological development of the science, with assigned reading. Second term (1).

Deposits to cover breakage, chemicals, etc., are required as follows: Ten dollars each in Courses 416 and 420; fifteen dollars in Courses 391, 392, 418 and 423; twenty dollars in Course 409; twenty-five dollars in Courses 395, 401, 406 and 412; thirty dollars each in Courses 400, 403, 404, 413 and 414; forty dollars in Course 411. The unused portion of the deposit is returned to the student.

Summer Schools. Courses in Qualitative Analysis and Stoichiometry begin July 14, 1920, and continue four weeks. The course in Quantitative Analysis begins on the same date and continues for five weeks. The required course in Assaying begins June 16, 1920, and a second course may be given later. They are open to all persons prepared to take them.

SHIP CONSTRUCTION AND MARINE TRANSPORTATION

PROFESSOR FOGG, ASSOCIATE PROFESSOR CHAPMAN, ASSISTANT PROFESSOR BECKER

450. Ship Construction. One recitation and two drawing periods a week. A study of the construction of modern steel ships. The class-room work is paralleled by drawing-room exercises where the student works up a number of construction drawings based on the rules of the Registration Societies. Full treatment is given to both longitudinal and transverse types of construction. First term (3).

451. Ship Construction. A continuation of Course 450, which takes up details of ship construction, bow and stern construction, and special types of construction. During the courses 450

and 451 the student fairs a set of ship's lines and cuts a model; the model is later used for laying out shell plating. Second term (2).

452. Naval Architecture. Displacement, stability, trim and launching. The class-room work is paralleled by calculations in the drawing room. A displacement sheet is worked up, a curve of stability calculated by the use of the integrator, and launching calculations carried out. Second term (2).

453. Naval Architecture. Stability, rolling, resistance, powering of ships and propellers. The major part of this course is given up to the speed and power of ships: the effect of size, form and coefficients on speed; appendage resistance; models and model tanks. The use of model tank and trial data for the powering of ships is given full treatment. A study is made of propellers and the influence of the hull on the action of the propeller. Preparation required: 452. First term (3).

454. Naval Architecture. Strength of ships, steering and maneuvering, freeboard and subdivision. A rigid treatment is given to the longitudinal and transverse stresses on a ship in a seaway and is paralleled by calculations of longitudinal strength in the course in ship design. The legal requirements of freeboard and bulkhead subdivisions are taken up in some detail and the class-room work is applied to the problem in the course in ship design. Preparation required: 453. First term (2).

455. Marine Engineering. The marine power plant and the layout of machinery on shipboard. Boilers, reciprocating steam engines, turbines, combination machinery and Diesel engines; fuels, combustion, draft and draft apparatus; condensing apparatus and ship auxiliaries. Preparation required: 227. Second term (3).

456. Structural Steel Design. A study of the stresses acting on steel structures, with special attention to the local stresses in a ship's structure; the design of cranes, warehouses and other steel structures. Solution of problems by graphic methods is also taken up. Preparation required: 167. First term (4).

457. Ship Design. Lectures and drawing-room work. In this course and Course 458 each student carries through a design for assigned requirements which parallels the class-room work. In this designs he works up the dimensions, coefficients, displacement, estimated weights and lines; stability under various conditions

of loading; power and propeller requirements; freeboard and bulkhead subdivisions as required by law; strength calculation; and cargo handling arrangement. The lectures also cover the design of boats for inland water navigation. Preparation required: 450, 453, 455. First term (3).

458. Ship Design. A completion of the work of course 457. The lectures in this course also cover the principles of heating, ventilation and refrigeration and some of the economic aspects of ship design and operation. Preparation required: 457. Second term (4).

459. Shipyard Plants and Terminal Facilities. A study of the methods of constructing ships; shipyard layouts and management. This is followed by a study of the loading and unloading of ships, cranes, piers, storage sheds, warehouses and railroad facilities and the other factors involving a quick "turn around" of a ship in port. Lectures, conferences and inspection trips. Second term (3).

MILITARY SCIENCE AND TACTICS

A unit of the Reserve Officers' Training Corps was established at Lehigh University in September, 1919, under the provisions of General Orders No. 49 and Special Regulations No. 44 of the War Department, with Lieutenant-Colonel John W. Lang, U. S. A., as Professor of Military Science and Tactics. Conducted on a voluntary basis, the unit has a membership of more than 300 students and the work is highly successful. The Trustees of the University, being convinced of the educational value of military training, have made military science and tactics a required subject, under the R. O. T. C. regulations, for Freshmen entering in September, 1920. Provision for this training is to be made in their schedules of study.

The military courses contemplated under the War Department regulations consist of two years of basic work and two years of elective advanced work along specialized lines. A student taking the courses for four years becomes eligible, upon graduation, for a commission in the Reserve Corps of the United States Army.

The courses in the University for 1919-1921 are:

470. Basic Course. Fundamental military training common to all arms of the service. Three hours a week, two theoretical and

one practical. Theoretical instruction consists of lectures, recitations, and quizes on organization, military courtesy and discipline, infantry drill regulations, care and handling of arms and equipment, small arms firing, interior guard duty, sanitation, minor tactics, morale, and physical training. Practical instruction given in infantry drill, bayonet exercises, target practice, physical drill, ceremonies, and field problems in minor tactics. First and second terms (3).

471. Basic Course. Second year. Two hours a week fundamental military training common to all arms and liaison, topography and map reading, signaling. One hour a week special branch of service: Infantry, Signal Corps, Coast Artillery, or Engineers. Courses 474 or 477 or 480 or 483. First and second terms (3).

The following advanced elective courses are in contemplation:

472. Advanced Course. Third year. Two hours a week for all arms. Camp sanitation, care of troops in the field, minor tactics, liaison for all arms, topography, field engineering, law, common and military; military policy of the United States. Three hours a week for special branch: Courses 475 or 478 or 481 or 484. First and second terms (5).

473. Advanced Course. Fourth year. Two hours a week all arms. Minor tactics, topography, field engineering, company administration, military policy, military history, economics, military law, courts martial, rules of land warfare, hippology. Three hours a week for special branch: Courses 476 or 479 or 482 or 485. First and second terms (5).

474. Infantry Special. Second year. One hour. Drill, hand grenades, bayonet combat, field engineering, orders and messages. First and second terms (1).

475. Infantry Special. Third year. Drill, auto rifles, rifle grenades, 37 m/m guns, light (Stokes) mortars, machine guns, marches, care and handling of equipment, small arms firing, preliminary instruction, position and aiming drills, sighting drills, gallery practice, coaching, automatic rifles, rifle grenades, interior guard duty, road and position sketching, bridge construction, explosives and demolitions, orders and messages, military courtesy and discipline, minor tactics. First and second terms (3).

476. Infantry Special. Fourth year. Infantry drill, tactical exercises, musketry, ceremonies, marching, care and handling of arms and equipment, pistol practice, rifle grenades, target practice, sanitation, interior guard duty, topography, orders and messages, tactical walks, military history. First and second terms (3).

477. Coast Artillery Special. Second year. Coast Artillery matériel. First and second terms (1).

478. Coast Artillery Special. Third year. Gunnery, orientation, Coast Artillery drill regulations. First and second terms (3).

479. Coast Artillery Special. Fourth year. Exterior ballistics, ordnance, organization of the Artillery. Tactical problems in artillery. First and second terms (3).

480. Engineer Special. Second year. Military map making, organization of engineering troops, military bridges and river crossings, fortification, camouflage, trenches, accessories, machine gun emplacements, obstacles, shelter, organization of the ground roads and communications, repair of worn and shell-torn roads. First and second terms (1).

481. Engineering Special. Third year. Military map making; light railways, location, construction, maintenance and operation; explosives, demolitions and mine warfare, fortifications, academic engineering of military value. First and second terms (3).

482. Engineer Special. Fourth year. Military map making and map reading, functions of staff, relation of engineers with particular relation to special engineer services, map problems involving engineering problems encountered during war, terrain exercises involving engineering problems encountered during war. Organization and administration of engineering projects, thesis on military engineering subjects, academic engineering courses of military value. First and second terms (3).

483. Signal Corps Special. Second year. Field radio sets, transmission and reception of messages by radio. First and second terms (1).

484. Signal Corps Special. Third year. Elementary telephone, telegraph and radio engineering. First and second terms (3).

485. Signal Corps Special. Fourth year. Advanced telephone, telegraph and radio engineering. First and second terms (3).

PHYSICAL EDUCATION

PROFESSOR REITER, MR. BARTLETT, MR. KANALY

500. GYMNASIUM. Class exercises in the open air, consisting of setting-up work for correct carriage. Work with dumb bells, wands, and Indian clubs to stimulate circulation, respiration, muscular action and to produce co-ordination and grace. Squad work on the heavy apparatus is given to develop strength in the larger muscles; recreative work in games and competitive exercises, to develop the play and combative elements. Stress is laid upon various athletic dancing. The various drills and athletic dances are accompanied by music. During the fall and winter the regular gymnasium work may be replaced by Rugby and soccer football, lacrosse, wrestling and basketball. During the spring, Varsity and Freshman baseball, tennis and lacrosse may be substituted for regular, required gymnasium work. All students who participate in an organized sport, under the oversight of the Director, are excused from the regular gymnasium work during the period of that sport. Special instruction is given in boxing and wrestling. Stress is laid upon athletic and æsthetic dancing. In addition to the regular required gymnasium work, each student in order to receive credit must swim at least the length of the pool. During the fall and winter months opportunity to learn to swim is afforded, under a competent instructor. Classes in the modern dances are held twice a week during part of the winter. Voluntary classes in advanced apparatus work are conducted for those who are interested. Short talks are given to the Freshmen on personal hygiene and the physiology of exercise. Entering students are given a thorough physical examination, and a medical examination by the consulting physician, who is in attendance also at athletic contests. Advice is given as to postural and physical defects. Each student receives a plotted card showing his defects and his relation to the normal student. The privilege of a second physical examination is given, thus affording a comparative statement and plotting of the student's physical condition. Freshmen, Sophomores, Juniors, Seniors and graduate students are required to do two hours' gymnasium work under supervision, unless participating in an organized sport, in season. First and second terms; for Freshmen, Sophomores, Juniors, Seniors, Graduate Students, (1).

501. First Aid to the Injured. This course is designed to give the student a practical knowledge of the most efficient methods of giving first aid to the injured. A brief resumé of the important points in anatomy are taken up, followed by consideration of shock, dislocation, fractures, rabies, hemorrhage, burns, sunstroke, frost bite, electricity and lightning stroke, poisons and their antidotes, drowning, asphyxiation, railroad and mining injuries. Students are required to do practical work in bandaging, applying splint and tourniquets, and to become familiar with the ordinary first aid materials and methods of transporting the injured. Second term (1).

CONFERENCE DEPARTMENT

PROFESSOR LAMBERT,
PROFESSOR PALMER, PROFESSOR ULLMANN, PROFESSOR MAC NUTT

The Conference Department provides extra instruction in Mathematics, Modern Languages, Physics, and Chemistry for Freshmen and Sophomores. Provision is made for two classes of students.

Class A. Any student who wishes to clear up some difficulty in the Mathematics, Modern Languages, Physics, or Chemistry of the Freshman or Sophomore year, should consult the teachers in the Conference Department on Wednesday and Saturday afternoons.

There is no fee for Class A students.

Class B. Students who are advised by the Dean or by the Heads of Departments or by the Committee on Standing of Students to take extra instruction in the Conference Department, or students who decide to do so of their own volition, can arrange for extra instruction for any period not less than one week by consulting the Director of this Department, who will be found in his office in Packer Hall at 6:45 P.M. on Monday, Tuesday, Thursday and Friday of each week. The hours of instruction are from 7 to 8 and 8 to 9 on the evenings of these four days.

The Fee of Class B Students, $1.50 for four consecutive recitations, must be paid in advance to the Bursar.

EXTENSION COURSES

During the year 1919-20, the extension courses of the University have been of two kinds:

1. Courses not of collegiate grade given in the Lehigh Evening School, which is also the practice school of the Department of Philosophy and Education. These include courses in Mathematics, Mechanical Drawing, Blue Print Reading, Machine Design, Applied Electricity and Metallurgy.

2. Courses certified to be of collegiate grade. Below is the list of such courses offered. All courses marked "G" may be offered by graduate students toward the higher degrees; courses marked "g" may be so offered under conditions prescribed by the department offering the course, and with the express consent of the Committee on Higher Degrees. The letter "e" is used to indicate courses that are open to students not matriculated in the University.

PHILOSOPHY, PSYCHOLOGY AND EDUCATION

PROFESSOR HUGHES, ASSISTANT PROFESSOR DROWN

EDUCATION. 1e. EDUCATIONAL PSYCHOLOGY. *Psychology of the Common Branches*, Freeman; *The Educative Process*, Bagley. (2) or (3).

EDUCATION. 2eg. PSYCHOLOGICAL MEASUREMENTS AND MENTAL HYGIENE (2).

EDUCATION. 3eg. SOCIAL PSYCHOLOGY. A psychological study of sport, art, morality, and religion. (2).

EDUCATION. 4e. ELEMENTARY SCHOOL METHODS. *Teaching in the Elementary School Subjects*, Rapeer. (2).

EDUCATION. 5eg. EXPERIMENTAL EDUCATION. *Experimental Education*, Rusk. (2).

EDUCATION. 6e. EDUCATIONAL MEASUREMENTS. *Educational Measurements*, Monroe, de Voss and Kelly. (2).

EDUCATION. 7eG. EDUCATIONAL MEASUREMENTS. Investigations and Reports. (2).

EDUCATION. 8eG. SECONDARY EDUCATION. *The Principles of Secondary Education*, Inglis. (4).

EDUCATION. 9eG. SCHOOL ADMINISTRATION. *Public School Administration*, Cubberley. (4).

EDUCATION. 10eG. SEMINAR IN EDUCATION. Reports and Discussions. Saturday P.M.

EDUCATION. 11e. HISTORY OF EDUCATION. Athens, The Renaissance, Rousseau, Herbart, Schools of Today, and of Tomorrow. (3)

EDUCATION. 12e. EDUCATIONAL SOCIOLOGY. *Syllabus*, Snedden. (2) or (4)

PHILOSOPHY. 1eg. HISTORY OF PHILOSOPHY. Evenings or Saturday A.M.

PHILOSOPHY. 2e. THE RELIGION OF PHILOSOPHY. *The Republic* and the *Symposium*, Plato; The Works of William James. (2)

PHILOSOPHY. 3e. ELEMENTARY LOGIC. *Logic*, Jones. (2)

ECONOMICS, PUBLIC LAW AND HISTORY

PROFESSOR STEWART, ASSISTANT PROFESSOR BOWEN

ECONOMICS. 1e. BUSINESS LAW. Contracts, agency and labor, business associations. Lectures and discussions. (2) Evenings.

ECONOMICS. 2e. ACCOUNTANCY. Theory of debit and credit, depreciation, reserves and surplus, financial statements, corporation accounting, cost accounting. Lectures and discussions. (2) Evenings.

ECONOMICS. 3e. INVESTMENTS. The securities of corporations, bonds of governments, and municipalities; speculation; investments. Lectures and discussions. (2) Evenings.

ECONOMICS. 4e. CORPORATION FINANCE. Forms of business organization, promotion and methods of securing capital, management of capital, reorganization and bankruptcy. Lectures and discussions. (2) Evenings.

ECONOMICS. 5eg. SOCIOLOGY. Sociological and economic theory, and problems to which this theory may be applied.

ECONOMICS. 6e. BANKING. Principles of banking, and the place of the bank in the business world. Lectures and discussion. (2) Evenings.

HISTORY. 1e. INDUSTRIAL HISTORY OF THE UNITED STATES. *Economic History of the United States*, Bogart; *Outline of Industrial History*, Cressy. (2) Saturday.

HISTORY. 2e. POLITICAL AND SOCIAL HISTORY OF MODERN EUROPE. Lectures and discussions. Special reference to the causes of the World War. (2) Evenings.

LATIN

PROFESSOR BLAKE

LATIN. 1e. A course corresponding to the work of the Freshman years in college. (2), (3) or (4). Evenings or Saturday A.M.

LATIN. 2eg. An advanced course. (3) Saturday A.M.

FRENCH

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY, MR. SOURBER

FRENCH. 1e. ELEMENTARY FRENCH. (3) Evenings or Saturday A.M.

FRENCH. 2e. ELEMENTARY FRENCH, continued. Course in reading and conversation. (3) Evenings or Saturday A.M.

FRENCH. 3eG. RECENT FRENCH LITERATURE. Investigation and discussion of phases of French life as exemplified in French literature. Rapid reading. (3) Tuesday, Thursday, Friday, 4:30 to 6 P.M.

SPANISH

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

SPANISH. 1e. ELEMENTARY SPANISH. (3) Saturday A.M., or Tuesday, Thursday, Friday, 4:30 to 6 P.M.

SPANISH. 2e. ELEMENTARY SPANISH, continued. (3) Saturday A.M., or Tuesday, Thursday and Friday, 4:30 to 6 P.M.

GERMAN

PROFESSOR PALMER, ASSISTANT PROFESSOR MORE

GERMAN. 1e. ELEMENTARY GERMAN. German Grammar and Composition. Easy German Texts. (2) Saturday A.M.

GERMAN. 2e. INTERMEDIATE GERMAN. German Prose and Poetry. Heine, Keller, Meyer, Freytag, Storm, Heyse. (3) Saturday A.M.

GERMAN. 3e. Goethe's *Faust*, Part I. Lectures and Composition, or Nineteenth Century German Drama. (3) Saturday A.M.

GERMAN. 4eG. Goethe's Dramas, or Schiller's Life and Work, or Middle High German. (3) or (5) Afternoons, 4 to 6.

GERMAN. 5e. Teachers' Course in methods of teaching, discussion of text-books, phonetics of German, advanced German grammar and syntax, advanced composition. (2) Saturdays or afternoons.

ENGLISH

PROFESSOR THAYER, PROFESSOR LUCH,
ASSISTANT PROFESSOR MESCHTER, ASSISTANT PROFESSOR WALTERS

ENGLISH. Summer courses only can be assured at present, to meet any specific demand, of a grade coresponding to the work of the Freshman class in college in either term; the details to be arranged between the applicant and the instructor offering each course. During the past academic year a course was given in English Composition.

METALLURGY

PROFESSOR RICHARDS, ASSISTANT PROFESSOR ROUSH, MR. BUTTS

METALLURGY. 1e. GENERAL METALLURGY. (2) Evenings.

METALLURGY. 2e. METALLURGY OF IRON AND STEEL. (2) Evenings.

GEOLOGY

PROFESSOR MILLER, ASSISTANT PROFESSOR TURNER

GEOLOGY. 1e. GENERAL GEOLOGY. Lectures, field trips and laboratory. Study of geologic processes and results. (4) Saturday P.M.

GEOLOGY. 2e. GEOLOGY OF PENNSYLVANIA. Lectures, field trips and laboratory. Geological history of the State and its bearing on economic and political development. (4) Saturday P. M.

GEOLOGY. 3e. APPLICATIONS OF GEOLOGY to the teaching of Physical Geography. Illustrated lectures; discussion of school problems. (4) Evenings.

GEOLOGY. 4eG. The graduate courses listed on page 134 may be pursued as extension courses by qualified students.

BIOLOGY

PROFESSOR HALL, MR. REX

BIOLOGY. 1eg. GENERAL COURSE. Lectures, laboratory and discussions. (2), (3), (4) Saturday P.M.

BIOLOGY. 2eg. COMPARATIVE ANATOMY. Lectures, laboratory and discussions. (2), (3), (4) Saturday P.M.

BIOLOGY. 3eg. BACTERIOLOGY AND SANITARY BIOLOGY. Lectures, laboratory and discussions. (2), (3), (4) Saturday P.M.

BIOLOGY. 4eg. EMBRYOLOGY. Lectures, laboratory and discussions. (2), (3), (4) Saturday P.M.

BIOLOGY. 5eg. The graduate course listed on page 136 may be pursued as an extension course by qualified students. Afternoons, 4 to 6, or Saturdays.

BIOLOGY. 6eg. FORESTRY. Lectures, laboratory and discussion. (3) Saturday P.M.

PHYSICS

PROFESSOR MAC NUT, ASSOCIATE PROFESSOR CHARLES, ASSISTANT PROFESSOR FRY, ASSISTANT PROFESSOR FRAIM

PHYSICS. 1e. ELEMENTARY PHYSICS. A brief general course; lectures, demonstrations, recitations and laboratory. (4) Saturday P.M.

ELECTRICAL ENGINEERING

PROFESSOR ESTY,
ASSOCIATE PROFESSOR SEYFERT, ASSISTANT PROFESSOR SCHEALER, ASSISTANT PROFESSOR BEAVER, ASSISTANT PROFESSOR GRUBER, MR. ESHBACH

PRINCIPLES OF DIRECT CURRENT GENERATORS AND MOTORS. 1e. This course of twenty weeks is arranged for high school graduates, or for men who have had some algebra, plane geometry, mechanics, and heat. It includes the study of the principles of direct currents, Ohm's law, the magnetic circuit, line drop, generators, motors, efficiency and losses, motor starters, automatic starters, storage batteries and direct current plant operation. Two evenings, one for class work, the other for laboratory work, are required. Laboratory fee, $5, in addition to a charge of $10 for the course. (2) Evenings.

PRINCIPLES OF ALTERNATING CURRENT MACHINERY. 2e. This course of twenty weeks is arranged as a continuation of course 1e above described. The preparation required is course 1e, or its equivalent. About eight weeks are spent in the study of alternating currents and the working of numerous numerical problems. The remaining twelve weeks are devoted to study of the alternating current generator, synchronous motor, transformer, synchronous converter, single and polyphase induction motors, etc. Two evenings a week are required. Laboratory fee, $5, in addition to a charge of $10 for the course. (2) Evenings.

CHEMISTRY

PROFESSOR ULLMANN, ASSOCIATE PROFESSOR BABASINIAN

CHEMISTRY. 1e. ELEMENTARY CHEMISTRY, with laboratory. (2) or (4). Laboratory fee of $10, in addition to a charge of $10 for the single and $20 for the double course. A summer course only.

CHEMISTRY... 2e. ORGANIC CHEMISTRY. Fee $20. (3) or (4) Saturdays.

SUMMER TERMS

Summer term courses are required as follows: Land and Topographic Surveying at the end of the Freshman year in the courses in Civil Engineering, Mining Engineering and Ship Construction and Marine Transportation; Constructive Elements of Machinery and of Electrical Apparatus at the end of the Freshman year in the courses in Mechanical Engineering, Metallurgy, Electrical Engineering and Chemical Engineering; Mechanical Technology at the end of the Sophomore year in the courses in Mechanical and Electrical Engineering ; Assaying at the end of the Sophomore year in the courses in Metallurgy, Mining Engineering and Chemistry; Assaying and Industrial Mineralogy at the end of the Sophomore year in the course in Chemical Engineering; Engineering Laboratory at the end of the Junior year in the courses in Mechanical Engineering and Chemical Engineering; Mine and Railroad Surveying at the end of the Junior year in the course in Mining Engineering. In certain cases students may, with the approval of the Heads of their Departments, substitute industrial work for summer courses. Students not connected with the University may be admitted to the courses in Surveying if properly qualified. For this purpose special arrangement must be made with the Professor of Civil Engineering for the courses in Land and Topographic Surveying, and with the Professor of Mining Engineering for the course in Mine and Railroad Surveying.

GRADUATE COURSES

Courses leading to the degree of Master of Arts or Master of Science may, by permission of the Faculty, be pursued by any properly qualified person who has taken the Bachelor's degree or a degree in technology at any recognized college, university or technical institution. These courses require at least one year of advanced study in residence at Lehigh University in two departments (under two professors), or at least two years of such study in non-residence. Residence is construed as continuous attendance at the University and living under its jurisdication. Permission to enroll for study in non-residence will be granted only in exceptional cases to students who possess ample facilities for study and work and usually only to students who can report periodically in person for conferences with the professors under whom they are studying.

The course of study selected must consist of at least fifteen exercises a week. Two-thirds of the work, ten hours a week, including a thesis, if required, must be chosen in one department called the major department. The work in the major department is to be selected from the list of graduate studies. About one-third of the work is to be in another department, called the minor department, and may be chosen from the list of graduate studies or from other advanced courses offered by the University. The candidate is required to satisfy each professor concerned that he is fully competent to pursue the subjects selected.

Candidates may be enrolled at any period of the college year, but preferably at the beginning of the regular terms in September and February.

The fees for instruction are $100 a year for students in residence, and $50 a year for studies in non-residence, payable in advance (or as arranged with the Bursar's office). A student in residence who takes more than one year shall have returned to him a pro-rata part of his payment for the second, or other succeeding years, if he finishes in a fraction of that year. A student in non-residence shall pay for the first two years; no fee will be required for the third year, but succeeding years, if necessary and permitted by the Faculty, shall be paid for at the rate of $50 a year. The graduation fee of $10 is required of all students.

After passing examinations in the assigned studies, presenting a satisfactory thesis as evidence of ability to do original work, if

required by the professor concerned, and paying all required fees, the candidate will be recommended by the Faculty to the Trustees for the Master's degree appropriate to the course pursued.

Some of the University Extension Courses listed on page 122 are designated as graduate courses. As these are given late in the afternoon, or in the evening, or on Saturdays, they are especially adapted to teachers and others who are enrolled as graduate students in non-residence.

The following graduate studies are now offered by the University:

MATHEMATICS AND ASTRONOMY

PRACTICAL ASTRONOMY

PROFESSOR THORNBURG, PROFESSOR OGBURN

The work embraces: (*a*) The study of instruments and methods used in the determination of time, latitude, longitude, and azimuth; (*b*) practical work in the observatory, securing facility in making and reducing observations. Two terms (5).

DIFFERENTIAL EQUATIONS

PROFESSOR LAMBERT

The course in Differential Equations is based on Johnson's *Differential Equations* and Byerly's *Spherical Harmonics*. Collateral reading in the University Library is required. Two terms (3).

ANALYTIC MECHANICS

ASSISTANT PROFESSOR REYNOLDS

Elementary and Advanced Rigid Dynamics; Potential Functions, based on Love's *Theoretical Mechanics*; Williamson and Tarleton's *Dynamics*; and Routh's *Dynamics*. Two terms (3).

DIFFERENTIAL GEOMETRY

ASSISTANT PROFESSOR KNEBELMAN

Parametic representation of plane and skew curves and surfaces, theory of contact, curvature, differential invariants, intrinsic equations, trajectories, equations of Césaro, curvilinar coordinates, equations of Lamé.

Representation of one plane upon another, conformal and spherical representation. equations of Gauss and Godazzi, theory of applicability. Two terms (2).

ENGLISH

ENGLISH LITERATURE

PROFESSOR THAYER

An advanced course in branches which have not formed a part of the undergraduate work of the candidate, the details of which will be arranged after a personal conference. Two terms (5).

ANGLO-SAXON

ASSISTANT PROFESSOR MESCHTER

Anglo-Saxon poetry and prose above the grade of undergraduate work, from both the literary and the historical points of view. Two terms (5).

ENGLISH PHILOLOGY

PROFESSOR LUCH

An advanced course in the principles of Teutonic philology as applied to the origin and development of the English language. Two terms (5).

SANSKRIT

PROFESSOR THAYER

Beginners' Course. Perry's *Primer*. Lanman's *Reader*. Whitney's *Grammar*. Two terms (5).

ECONOMICS AND HISTORY

POLITICAL ECONOMY

PROFESSOR STEWART

This course embraces: (*a*) The rise and development of economic systems and economic thought; (*b*) the scope and method of political economy. Patten's *Development of English Thought* and the works of Keynes, Cohn and Ingram on Political Economy will be used. Two terms (5).

AMERICAN HISTORY

PROFESSOR STEWART

An examination of the influence of the economic development of the Union upon the legal and political theories incorporated in the Constitution. Two terms (5).

POLITICS

PROFESSOR STEWART

The history of the attempt to treat in a systematic way the problems of political organization. Pollock's *History of the Science of Politics* and Sidgwick's *Elements of Politics.* Two terms (5).

LATIN

PROFESSOR BLAKE

An advanced course in the Latin language and literature. The course will be arranged with each candidate individually upon application. Two terms (5).

GREEK

Advanced courses, of which the following are specimens, will be arranged upon application.

HELLENISTIC GREEK

PROFESSOR GOODWIN

Gospel of St. Mark, Acts, and selected *Epistles of the New Testament.* Thayer's *Lexicon.* Blass's *Grammar of New Testament Greek.* Patristic literature. Collateral reading. Selections from Lucian. Two terms (5).

DRAMATIC POETRY

PROFESSOR GOODWIN

Several plays of Aeschylus, Sophocles, Euripides, and Aristophanes. Aristotle's *Poetics.* Collateral reading. Two terms (5).

GREEK PHILOSOPHY

PROFESSOR GOODWIN

Plato's *Republic* and other works. Aristotle, selections. Ritter and Preller's *Historia Philosophiae Graecae.* Zeller's *History of Greek Philosophy,* and other collateral reading. Two terms (5).

ELECTRICAL ENGINEERING

THEORY OF ALTERNATING CURRENTS AND ALTERNATING CURRENT MACHINERY

PROFESSOR ESTY

This course is based upon the works of Arnold, Bedell and Crehore, Steinmetz, and Lawrence. Two terms (4).

ELECTRICAL DESIGN

PROFESSOR ESTY

This course consists of predeterminations by calculation of the characteristics, regulation and performance of electrical machinery. Analysis and use of designing constants. Design of special machines. Two terms (3).

ELECTRIC TRACTION

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT

The development of an electric railway project. Design of station and distribution system. Operating characteristics of direct and alternating current railway motors. Predetermination of motor equipment and run curves for given schedules and traffic. Choice of system. Estimates of costs. Two terms (3).

ELECTRICAL TESTING

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT

Special experimental research in electrical engineering; tests of the magnetic properties of iron and steel; investigation of the series single-phase alternating current motor; leakage reactance of induction motors; regulation of alternators; polyphase testing; electric railway testing. Two terms (3).

RADIO COMMUNICATION

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT, MR. ESHBACH

The theory underlying the various sending and receiving systems, and the propagation of electromagnetic waves, combined with experimental work in connection with the department's wireless equipment. Two terms (2).

METALLURGY

THERMO-CHEMISTRY AND THERMODYNAMICS OF THE METALS

PROFESSOR RICHARDS, ASSISTANT PROFESSOR ROUSH

A study of the melting points, vapor tensions, specific heats, and latent heats of fusion and of vaporization of the metals, from practical and theoretical viewpoints; also, of the heats of formation of compounds of the metals, and the relation of these to atomic weights and other chemical and physical properties. Lectures and laboratory work. First term (5).

THERMO-CHEMISTRY AND PHYSICS OF METALLIC ALLOYS

PROFESSOR RICHARDS, ASSISTANT PROFESSOR ROUSH

A study of the physical and chemical properties of metallic alloys, their melting points, specific heats, latent heats of fusion, heats of formation and microscopic structure. Lectures and experimental work. Second term (5).

ELECTROMETALLURGY

PROFESSOR RICHARDS, ASSISTANT PROFESSOR ROUSH

A study of the conditions of deposition of metals and alloys in electrolysis, electrolytic separations, formation of metallic compounds by electrolysis, energy absorption in electrolysis. Lectures and laboratory work. First term (5).

MINING ENGINEERING

METHODS OF MINING

PROFESSOR ECKFELDT

The study of methods used in a given mining region, or in the production of a given class of mineral, with respect to conditions influencing choice of method and cost. Two terms (5).

MINING PLANT

PROFESSOR ECKFELDT

The determination of the efficiency of mining machinery of given types under varying conditions. Two terms (5).

ORE DRESSING PLANT

ASSISTANT PROFESSOR BARTLETT

The study of certain operations incident to the dressing of ores or the preparation of coal. Determination of efficiency of machines and processes. Losses in dressing. Two terms (5).

GERMAN

PROFESSOR PALMER, ASSISTANT PROFESSOR MORE

The German Drama of the Nineteenth Century. First and second terms (3).

Lessing as Dramatist and Critic. First and second terms (3).

Middle High German. Wright's *Middle High German Primer*, Bachmann's *Mittelhochdeutsches Lesebuch*, Nibelungenlied. First term (3).

Middle High German. Gudrun, Wolfram von Eschenbach, Gottfried von Strassburg, Walter von der Vogelweide. Lectures on Middle High German literature. Second term (3).

GEOLOGY

GEOLOGICAL INVESTIGATION

PROFESSOR MILLER

The investigation and study of the literature of some special geological problem. This comprises field and laboratory work on some district. A map of a limited area is constructed, the microscopic character and general structural features of the rocks which are exposed are investigated and a thesis or dissertation embodying these results are presented. Preparation required depends upon the nature of the problems to be studied. Two terms (4).

ECONOMIC GEOLOGY

PROFESSOR MILLER

Advanced work in ore deposits. Study of the literature and of the theories of ore desposition, together with detailed work on the type occurrences of some one of the metallic or non-metallic minerals. The student is required to make a thorough investigation tion and report on some mining district with special regard to the origin of the ores and such commercial aspects of the deposits as may depend chiefly on the geology. Preparation required: 270 or 271. Two terms (6).

PETROGRAPHY

ASSISTANT PROFESSOR TURNER

A critical study of recent advances in petrographic methods and nomenclature. Preparation of a detailed report on a selected problem. Preparation required: 266, 268, 269 and 276. Second term (3).

PHYSIOGRAPHY

PROFESSOR MILLER

The detailed study of physiographic types and processes. Conferences, reports and thesis, with work in the laboratory and field. A training in elementary physiography and general geology is required as a pre-requisite. Two terms (4).

PHYSICAL CRYSTALLOGRAPHY

ASSISTANT PROFESSOR TURNER

An advanced course in the geometrical and physical properties of crystals, with special reference to the Goldschmidt methods of crystal measurement and projection. First term (4).

BIOLOGY

VERTEBRATE HISTOGENESIS AND ORGANOLOGY

PROFESSOR HALL

Lectures, reading, and laboratory work. In the laboratory the development of a vertebrate is carefully followed, tracing the history of the germ-layers, organs and tissues. The organology deals with the association of tissues to form organs. Preparation required: 292, 293, 294. First term (3).

PHILOSOPHY, PSYCHOLOGY AND EDUCATION

PROFESSOR HUGHES, ASSISTANT PROFESSOR DROWN

The following undergraduate courses may count toward an advanced degree provided additional work is taken in connection with them: History of Philosophy, ancient and modern, History of Education, Educational Psychology, Principles and Practice of Teaching, and Psychological Studies. More advanced courses in Psychology, Logic, Ethics and Metaphysics, may be outlined to meet the needs of competent students. The following is the course that commonly is followed by those who select Education as the major study:: Educational Psychology, two year hours; School Administration, two year hours; Secondary Education, two year hours; Seminar in Education, with Thesis, four year hours. Most students in the field of Education find it convenient to avail themselves of the Extension Courses, which are listed on page 122.

GRADUATE COURSES

PROFESSOR HUGHES

History of Philosophy, advanced course. Two terms (2).

Seminar in Philosophy. Two terms (2).

Educational Psychology. A. The relation to essential human needs of the several forms of culture—sport, art, the moral and religious consciousness, and the spirit of science; their origin

and development. One term (2). B. Psychological measurements and mental hygiene. One term (2).

Greek Education. One term (2).

ASSISTANT PROFESSOR BROWN

Educational Measurements. Investigation and reports. One term (2).

Secondary Education. Two terms (2).

School Administration. Two terms (2).

Seminar in Education. Two terms (2).

FRENCH

LITERATURE

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

An advanced course in French Literature. The course is arranged with each candidate individually upon application. Two terms (5) or (10).

LANGUAGE

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

A. OLD FRENCH. Grammar. Easier texts. Chanson de Roland. First or second term (2) or (3).

B. OLD FRENCH. Reading and explanation of texts. First or second term (2) or (3).

C. ROMANCE PHILOLOGY. Sound change. Word formation. First or second term (2) or (3).

D. ROMANCE PHILOLOGY. Syntax. First or second term (2) or (3).

CHEMISTRY

ADVANCED INDUSTRIAL CHEMISTRY

PROFESSOR ULLMANN, ASSISTANT PROFESSOR CHAMBERLIN

This course involves the study of some industry dependent upon chemical principles and consists of experimental and analytical work in the laboratories, inspection of manufacturing establishments, and study of the technical journals and other publications. Two terms (10).

ADVANCED ORGANIC CHEMISTRY

ASSOCIATE PROFESSOR BABASINIAN, ASSISTANT PROFESSOR COBB

This course consists of original investigations in organic chemistry. Two terms (10).

ADVANCED ANALYTICAL CHEMISTRY

PROFESSOR ULLMANN, ASSOCIATE PROFESSOR DIEFENDERFER

Study and comparison of known methods of quantitative analysis and the development of new methods. Two terms (10).

PHYSICAL CHEMISTRY

DR. DARBY

This course consists of original investigations in physical chemistry. Two terms (10).

PHYSICS

THEORETICAL PHYSICS

PROFESSOR MAC NUTT, ASSOCIATE PROFESSOR CHARLES

Elective courses are offered in the following subjects: (*a*) The Theory of Heat, based upon Preston's *Theory of Heat*, Buckingham's *Thermodynamics*, and Nernst's *Theoretical Chemistry*; (*b*) The Theory of Electricity and Magnetism, based upon Maxwell's Treatise, J. J. Thompson's *Recent Researches*, and *Conduction of Electricity Through Gases*, and Hertz's *Electric Waves*; (*c*) The Theory of Light, based upon Preston's *Theory of Light*, Drude's *Theory of Light*, Wood's *Physical Optics*, and Edser's *Light for Advanced Students*. First and second terms (3) to (5).

PHYSICAL RESEARCH

PROFESSOR MAC NUTT, ASSOCIATE PROFESSOR CHARLES

Advanced students are given an opportunity to pursue experimental investigations in physics. First and second terms (2) to (4).

CIVIL ENGINEERING

BRIDGE DESIGN

PROFESSOR FOGG

The theory of suspension and arched structures, with the preparation of general plans and estimates, and the economic comparison of different types. Two terms (4).

TESTING OF MATERIALS

PROFESSOR FOGG, ASSISTANT PROFESSOR FULLER

The properties of materials of construction, with special reference to inspection and testing. The student conducts original researches in the laboratory. The work on the unification of methods of testing done by the International Association for Testing Materials receives detailed attention. Two terms (5).

RAILROAD ENGINEERING

PROFESSOR WILSON

The economic location of railroads, as influenced by probable volume of traffic and cost of operation. A course based on Wellington's treatise, with detailed discussion of special cases. Two terms (2).

SANITARY ENGINEERING

ASSISTANT PROFESSOR PAYROW

The designing of reservoirs, tanks, and pipe lines for water supply systems, and of sewers and other appurtenances for sewerage systems. Inspection of existing plants, with reports thereon. Two terms (4).

TUITION AND OTHER FEES

The tuition fees for all students from September, 1920, are as follows: In the College of Engineering, $300 for the year or $180 for either term; in the College of Business Administration, $250 for the year or $150 for either term; in the College of Arts and Science, $200 for the year or $120 for either term.

The tuition for Chemistry offered in the Summer term immediately following Commencement Day is $15; for all other subjects $20. No charge is made for such subjects to students who have paid tuition for the previous year, provided the subjects in question are a scheduled part of the technical courses they are pursuing. A graduation fee of $10 is paid by all candidates for a degree. A registration fee of $10 is paid by each student yearly.

All fees are payable at the office of the Bursar in Drown Memorial Hall. Tuition fees are payable in two instalments, on the opening day of the college year in September, and on the first

day of the second term in February. The first instalment is $180, or $150, or $120, according to the course, and the second instalment is $120, or $100, or $80, according to the course. Application may be made for a return of part of the tuition fee when a student has formally withdrawn from the University after less than four weeks' attendance in either term, but the amount thus refunded will in no case exceed one-half of the last instalment paid.

Students who fail to pay tuition fees when due will be notified that their attendance at college exercises must be discontinued until payment is made.

EXPENSES

Books, stationery, and drawing instruments may be bought by students at low prices at the Supply Bureau in Drown Memorial Hall. For work in the laboratories, materials may be obtained from the University, students making a deposit at the opening of the term covering the value of the materials. The amounts of these deposits are given under the detailed statements of laboratory courses in the List of Studies.

The University dormitories accomodate 174 students. The charge for single rooms is $65 a year; suites of three or four rooms rent at $81 for each occupant.

Students may obtain table board at the College Commons. The rate for 1919-20 is $25 for thirty consecutive days, or $7 for a single week. Numerous private householders in the city offer rooms and board at moderate charge.

Necessary expenses for the collegiate year, clothing and traveling not included, are estimated at $500 in addition to tuition. This includes attendance at the required summer schools.

SITE

Bethlehem is situated at the junction of the Lehigh Valley, the New Jersey Central, and the Philadelphia and Reading Railroads. The university buildings are about a half-mile from the station. New York is eighty-six and Philadelphia fifty-seven miles distant.

BUILDINGS

PACKER HALL

Packer Hall, completed in 1869, is four stories in height, 215 feet long, and 60 feet wide. It is built of Potsdam sandstone in the English Gothic style of architecture, and occupies a commanding position, overlooking Bethlehem.

The Department of Civil Engineering occupies the greater part of the first and second floors of Packer Hall. On the first floor are a lecture room, two recitation rooms, a large drawing hall, two instrument rooms, two offices and a library room. The instrument rooms contain seventeen transits, fourteen levels, a large geodetic theodolite, two plane tables, and other instruments for engineering field work. In the library room is an excellent collection of plans of engineering structures. On the second floor are two drawing-rooms, three recitation rooms, an instrument room, a blue-print room, and offices.

On the third and fourth floors are to be found the offices and recitation rooms of the Department of Mathematics and Astronomy.

The offices of the President, Vice-President, Secretary of the Faculty and Registrar are located on the second floor of Packer Hall.

THE CHEMICAL AND METALLURGICAL LABORATORIES

The Chemical and Metallurgical Laboratories are contained in a fire-proof sandstone building, 259 feet in length by 44 in width, with a wing.

In the Chemical Department there are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories. These rooms are 22 feet in height, and are well lighted and ventilated. Laboratories for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a smaller lecture room, a recitation room, a chemical museum, and laboratories for organic, physical, and sanitary chemistry.

In the basement is a large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis; also rooms containing the apparatus for processes in industrial chemistry, steam engine and dynamo and motor installation, air pump for vacuum filtration, etc.

The University is now building an extension of the Chemical Laboratory which will be ready for occupancy in September, 1920. It will be three stories high, in architectural conformity with the main building, and will have inside dimensions of 60 feet by 37 feet. The equipment of these laboratories is designed to be of the most modern type, and every accessory to comfort and efficiency in expediting laboratory work is included in the plans.

The Metallurgical Department contains a lecture room; a museum of metallurgical collections; a laboratory provided with a spectroscope, a simple and a polarizing microscope, two Le Chatelier microscopes complete with camera; a dry laboratory provided with furnaces for solid fuel and for gas, with natural draught and with blast, electric current for electrometallurgical experiments, and a wet laboratory for ordinary analytical work. Equipment is provided for laboratory work in metallurgy, in metallography, and particularly in electrometallurgy, consisting of gas, electric current and apparatus for various kinds of experimental work; several new pyrometers, calorimeters, and furnaces have been added to the general equipment. This department is therefore well arranged and equipped for the instruction of classes in metallurgy and electrometallurgy of the regular curriculum, to afford facilities to students for familiarizing themselves with the methods of measurement and research employed in metallugy and electrometallurgy, and for conducting original investigations in these departments of science.

THE PHYSICAL AND ELECTRICAL LABORATORY

The Physical and Electrical Engineering Laboratory is 240 feet long, 44 to 56 feet wide, and four stories high. The halls and stairways, the photometer rooms, and all apparatus rooms are of fire-proof construction. The remainder of the building is of heavy mill construction.

On the first floor are the Advanced Electrical Laboratory and shops of the Physics Department, the Senior and Junior dynamo laboratories, the shop and research room of the Electrical Engineering Department, and a storage battery room belonging jointly to the Department of Physics and Electrical Engineering.

The dynamo laboratory for Senior students in the west wing is supplied with power from a 75-kilowatt rotary converter receiving current from the University power plant through two 30 kilowatt transformers. The dynamo laboratory equipment, which

is being constantly increased, now includes the following apparatus: an 18-kilowatt double current generator, two direct current motor-generator units, one Lincoln variable speed motor, a 4-kilowatt Westinghouse two-phase rotary converter, a 10-kilowatt General Electric six-phase compound rotary converter, two direct connected units consisting of 7½-kilowatt six-phase General Electric alternators driven by 15-horse power Allis-Chalmers motors, one 20-kilowatt two- (or three-) phase alternator built by the Department, a 35-kilowatt Westinghouse single-phase alternator, a 10-kilowatt composite wound alternator driven by a 15-horse power Crocker-Wheeler motor, a pair of 3-horse power direct connected series crane motors, three motor-generator sets converting from alternating to direct current, four polyphase induction motors ranging from 2-horse power to 7½-horse power, three types of single-phase induction motors, two single-phase commutator motors, twenty-two transformers of from 1 to 15-kilowatts, including two 15-kilowatt Scott-connected transformers, a 5-kilowatt 66,000-volt testing transformer, a 6-light constant current transformer, a 30-ampere arc rectifier outfit complete, a General Electric oscillograph outfit, and a variety of instruments, including voltmeters, ammeters, watt-meters, rheostats, contact makers, frequency meters, dynamo-meters, condensers, and other apparatus.

The dynamo laboratory for Junior students on the first floor in the west wing contains the following apparatus: a 20-kilowatt Ferranti alternator driven by a direct current motor, two arc light machines, twenty arc lamps of various types, a Brackett cradle dynamometer, a Westinghouse two-phase rotary converter, a motor driven battery-booster set, several types of adjustable speed motors, and other motors for direct and alternating currents.

On the second floor are the offices of the Departments of Physics and of Electrical Engineering, two general apparatus rooms, a large laboratory room for Physics, a large dynamo laboratory for Sophomore students in Electrical Engineering, and an Electrical Engineering reading room. The dynamo laboratory for Sophomore students in the west wing is equipped with twenty-seven direct current machines of various types, dynamotors and several types of automatic starters and auxiliary apparatus. Apparatus exemplifying the operation of telegraph, telephone, and radio telegraph and telephone stations are here installed. The equipment in radio telegraphy and telephony includes a 250-foot

antenna, 5-kilowatt transformer, oscillation transformer, quenched gap, and several sets of receiving apparatus.

On the third floor are the lecture room, apparatus rooms and photometer rooms of the Department of Physics, and lecture room, recitation rooms, apparatus room, and drawing-room of the Department of Electrical Engineering.

On the fourth floor are recitation rooms and two large laboratory rooms of the Department of Physics.

THE W. A. WILBUR ENGINEERING LABORATORY AND POWER HOUSE

The laboratory portion of this building was erected in 1902; in 1907 the original building was doubled in size, the addition containing the new heating and lighting plant of the University. The building is of sandstone, conforming in material to the adjacent Chemical and Physical Laboratories. It is 44 feet wide by 188 feet long, one story high in the boiler room, but with a raised engine room forming a second story at either end.

The boiler equipment of the laboratory consists of two water-tube boilers rated at about 100-horse power each, one of Babcock & Wilcox type, the other of Sterling make. In the heat and light plant there are three 250-horse power Sterling boilers, with room for a fourth unit of equal or greater capacity. Each section has its own set of feed pumps and other auxiliaries, in the arrangement of which special provision has been made for easily conducting performance tests. The laboratory boilers are connected to the chimney of the old boiler house, and have also an induced draft outfit. The chimney of the newer plant is of a radial brick construction, 125 feet high, and a forced draft equipment is to be installed when need for increased capacity arises.

A coal-storage yard north of the building has room for a season's supply of coal, and a system of belt-conveyors and bucket-elevator is provided for receiving coal, dumping it on storage pile, and conveying it into the boiler room as needed.

The engine room of the laboratory, 50 feet long, contains a vertical triple-expansion engine of 75-horse power, a 60-horse power compound two stage Ingersoll air compressor, a small tandem-compound yacht engine, a simple Ball engine direct connected to a 25-kilowatt Crocker-Wheeler generator, and a 5-horse power De Laval steam turbine. There is also a complete set of Westinghouse airbrake apparatus, with four freight car brakes. The air-

brake pump and all the other small motors, including the feed and condenser pumps, are piped to the surface condensers beneath the engine room floor. There are two large condensers of 150 and 60-horse power capacity respectively, with smaller ones for the pumps and for special experiments. Besides the various engines there is a large belt dynamometer, apparatus for testing gauges, indicators, thermometers, steam calorimeters and other instruments, and for experiment on flow of steam, for testing injectors, etc. The exhaust system includes a Cochrane feed-water heater of 250-horse power capacity.

The engine room of the power house is 31 feet long, with concrete floor. The generating units now installed are of 50 and 100-kilowatt rating, and there is room for a third of larger size. Simple horizontal Ball engines are direct connected to General Electric alternating current generators, which furnish 60-cycle two-phase current at 2200 volts for transmission to the various distributing centers. An engine-driven and a motor-driven exciter, with the switchboard, complete the electrical equipment. The engines exhaust through a Cochrane heater, and the exhaust steam is discharged directly into the low-pressure system during the heating season.

The abandonment and dismantling of the old boiler plant rendered available for laboratory use a floor space 45 feet by 70 feet in the old boiler house. This now contains a 150-horse power suction gas producer for anthracite coal and is also used for apparatus and experiment in gas-power engineering and hydraulics, and for a number of the minor thermodynamic experiments with steam.

This building bears the name of W. A. Wilbur in grateful recognition of the work he has done for Lehigh University.

WILLIAMS HALL

Williams Hall was the donation of Dr. Edward H. Williams, jr., of the Class of '75, and was so named by the Trustees of the University not only in recognition of this gift but also of Dr. Williams' long continued and important service to the University as an alumnus and as Professor of Mining and Geology.

Williams Hall is 186 feet long by 70 feet wide and covers a ground area of over 12,000 square feet. One-half of the building is devoted to the Department of Mechanical Engineering and the other half to the Departments of Geology and Biology.

In the eastern end are located the recitation rooms, instructors' offices, drawing-rooms, reference library, and store-rooms of the Department of Mechanical Engineering, and in the basement rooms and apparatus are provided for laboratory work in experimental mechanics and engineering physics, such as the calibration of the measuring instruments used in Mechanical Engineering, the determination of the mechanical efficiencies of hoisting and other gear, and the testing of motors. In this section there are electric motors, a water motor, a 15-horse power centrifugal pump, hoists, blocks, jacks, and dynamometers of various kinds.

In the west end the Department of Geology has on the first floor two lecture rooms, two offices, library, mineralogical museum, and laboratory of petrology and petrography. The lecture rooms contain specimens of rocks and fossils and a collection of economic minerals and ores. The main lecture room is fitted with a stereopticon for illustrated lectures The laboratory of petrography is provided with fifteen high-grade petrographic microscopes, and study collections of rocks and minerals. The collection of rocks contains over six thousand specimens from type regions in different parts of the world. The mineralogical museum contains many valuable collections representing all the prominent mineral localities of the world. In the basement are the mineralogical laboratory, the blow-pipe laboratory, a small chemical laboratory for analytical work, and a room fitted with apparatus run by a one-horse power motor for cutting thin sections of rock. On the second floor is the paleontological museum, which contains the fossil collections. On the third floor is a room fitted as an office and laboratory, containing a Goldschmidt's two-cycle goniometer and other apparatus for advanced work in crystallography.

On the third floor are located the drawing-room and an office of the Mining Department, also well-equipped blue-print and dark rooms and a photographic laboratory used jointly by the Departments of Mining and Geology.

The Department of Biology has its lecture room, office, reference library, laboratories, and store rooms on the second floor, and a large vivarium on the third floor. The laboratories of this Department are thoroughly equipped with collections, sections, microscopes, and necessary appliances.

Two students' rooms, used by the Mining and Geological Society and by the Mechanical Engineering Society, are located in the basement.

THE FRITZ ENGINEERING LABORATORY

The late John Fritz, of Bethlehem, known as the father of the steel industry in the United States, and a member of the Board of Trustees dating from the founding of the University, donated to the University the funds for the erection and thorough equipment of an engineering laboratory. The building was designed and erected in 1910 under the personal supervision of Mr. Fritz. It has been named by the Trustees "The Fritz Engineering Laboratory." The building is equipped with a general testing section for testing iron and steel, a cement and concrete section, and a hydraulic section. The equipment is used by the Civil Engineering Department in connection with courses in Strength of Materials, Hydraulics, and Cement. Any student in the University who has the proper preparation may receive instruction in this laboratory.

The building is of modern steel frame construction, 94 feet wide and 115 feet long, with the main central section 65 feet in height, and two side sections of lesser height. The external walls which enclose the steel frame are of cement brick lined on the inside with red brick. A traveling crane, of 10-ton capacity, operated by electricity, commands the entire central portion of the building in which the testing of large specimens is carried on.

The general testing section is equipped with an 800,000-pound Riehlé vertical screw testing machine, capable of testing columns 25 feet long or less, tensile specimens 20 feet long or less, and transverse specimens up to lengths of 30 feet; an Olsen universal testing machine of 300,000 pounds capacity; smaller machines for ordinary tension, compression, transverse and torsion tests; a cold-bend testing machine, and a small machine shop. The hydraulic section occupies the east end of the main room and is equipped with various tanks, weirs, pumps and other apparatus for studying problems in hydraulics. The cement and concrete section has one large room for the making and testing of specimens and one room for the storage of materials.

THE ECKLEY B. COXE MINING LABORATORY

The Eckley B. Coxe Mining Laboratory is situated south of Williams Hall and is of dressed sandstone. It is 100 feet long by 75 feet deep, one story high in front with a raised floor in the rear.

The main part of the building contains the Ore Dressing Laboratory, 40 feet by 70 feet; the west wing contains a chemical laboratory, an assay room, a balance room, and a sampling laboratory; the east wing contains the office, recitation room and an instrument room. A locker and wash room is located in the basement of the east wing.

The equipment for the main laboratory, most of which was made by the Allis-Chalmers Co., consists of a gyratory crusher, rolls, screens, jigs, Huntington mill, classifiers, concentrators (tables and vanner), gravity stamps, amalgamating plates, grinding pan, and cyanide plant, with the necessary apparatus including grizzly, elevators, feeders, sand-pumps, settling tanks, zinc boxes, filter press, dryers, crawls, blocks, and electric motors. The sampling laboratory contains a small jaw crusher, a small gyratory crusher, rolls, sample grinder, a magnetic separator, and a small air compressor.

The machinery is driven by seven separate motors, and any one part or all of it can be operated at will, permitting experimental studies and tests of individual machines or groups of machines, or of an entire process, as occasion may require. In this way the entire plant is made flexible and enables combinations of processes in order to determine the best possible method to pursue in the treatment of gold and silver ores, both free milling and sulphides, by amalgamation and cyanide processes, and of lead, copper, zinc, iron ores, etc., and of coals, by coarse and fine concentration.

Owing to the prominence which flotation methods have assumed in ore concentration, it has seemed advisable to equip a special department of the main laboratory for this work, and four types of testing machines have been installed, together with the necessary equipment of motors, etc., for their operation.

The following equipment, consisting of large and small size Ingersoll-Rand rock drills, Stoper and Jackhammer drills, an Ingersoll-Rand pick machine for coal mining, a Water-Leyner rock drill, a Sullivan hand-power diamond drill machine, and a Temple-Ingersoll electric-air drill, is housed in this building, also a full size mine car, a section track on steel ties and several sets of steel mine timbers.

This laboratory has been named by the Trustees of the University "The Eckley B. Coxe Mining Laboratory" in memory of Eckley B. Coxe, who was universally recognized as a pioneer and

a leader in the profession of Mining Engineering in this country, an active friend and valued Trustee of the University from its early days until his death. The Engineering and Mining Laboratories of Lehigh University, bearing the names of John Fritz and Eckley B. Coxe, record the friendship and close association of these two great engineers in their life-time, and their active interest in Lehigh.

CHRISTMAS HALL

Christmas Hall has historic interest as the first building of Lehigh University. It was originally a church, which was purchased from the Moravian Congregation. In the earliest years of the University it contained a chapel, lecture rooms and students' dormitory. After Packer Hall was completed in 1868, Christmas Hall and Saucon Hall were utilized as students' dormitories and mess hall up to 1885. For many years thereafter Christmas Hall was used by the Departments of Latin, Greek and Modern Languages. Classes of the Lehigh Evening School now meet in this building.

The offices of the Secretary of the American Electrochemical Society are located in the west end of Christmas Hall.

SAUCON HALL

Extensive alterations to Saucon Hall were made in 1896, adapting it to the needs of the Department of English. It contains a study and a recitation room for each instructor, a lecture hall seating 200 persons, and a large room on the ground floor which has been fitted up for the use of the literary societies, with committee rooms adjoining.

COPPÉE HALL

Coppée Hall, formerly the Gymnasium, was completely renovated in 1913 to adapt it to the needs of the Department of Arts and Science. On the first floor is a large lecture room, the office and recitation rooms of the Department of Economics and accounting rooms for instruction in Business Administration. On the second floor are the offices and recitation rooms of the Departments of Latin, Greek, German, Romance Languages, Philosophy and Education. The Psychological Laboratory, also situated on the second floor, is equipped for elementary instruction and experimentation in the psychology of sense and movement. On the third floor are the library and seminar room of the Departments of Arts and Science, also a large room for a museum and art gallery.

The building has been named by the Trustees of the University "Coppée Hall" in memory of Henry Coppée, M.A., LL.D., the first President of the University, who served in that capacity from the establishment of the University in 1866 to 1874; he retained his active connection with the University as Professor of English Literature, International and Constitutional Law and the Philosophy of History up to his death in 1895.

SAYRE OBSERVATORY

By the liberality of the late Robert H. Sayre, one of the Trustees of the University, an Astronomical Observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

The Observatory contains an equatorial telescope by Alvin Clark, of six inches clear aperture and of eight feet focus; a zenith telescope, by Blunt; a superior astronomical clock, by William Bond & Son; a meridian circle; a prismatic sextant, by Pistor and Martins; and an engineer's transit and a sextant, by Buff and Buff.

Students in practical astronomy receive instruction in the use of the instruments and in observation.

The land upon which the Observatory stands, consisting of seven acres adjoining the original grant, was presented to the University by the late Charles Brodhead, of Bethlehem.

Sayre Observatory Annex

Sayre Observatory Annex contains a modern zenith telescope of four and one-half inches clear aperture equipped with electric illumination. The building and instruments were presented to the University by the late Robert H. Sayre in 1903.

Observations secured with this instrument are for the purpose of investigating the Variation of Latitude.

THE PACKER MEMORIAL CHURCH

The Packer Memorial Church, in which daily chapel exercises are held, was the munificent gift of the late Mrs. Mary Packer Cummings, daughter of the founder of the University. It was built in 1887 and is one of the largest churches in the State. During 1909-10 it was thoroughly renovated; the walls were newly frescoed, new stained glass windows put in place, and electric lights installed. These improvements were made possible by the continued generosity of the donor, Mrs. Cummings.

THE UNIVERSITY LIBRARY

The Library building was erected by the founder of the University in 1877, at a cost of $100,000, as a memorial to his daughter, Mrs. Lucy Packer Linderman.

The building is semi-circular with a façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior there is a reading room 40 by 50 feet from which radiate book cases extending from floor to ceiling; two galleries afford access to the upper cases. Shelf room is provided for one hundred and sixty thousand volumes. One hundred and forty-four thousand volumes are now upon the shelves. The list of periodicals numbers about four hundred.

The Library is open from 8 A.M. to 6 P.M., except on Sundays and holidays.

The free use of the Library, with the privilege of taking out books, is offered to students of every department on presentation of their registration cards. The use of the books and of the periodicals within the building is free to all persons. Resident graduates of the University have the full use of the Library on payment of three dollars annually. Persons pursuing systematic investigation in any study may be allowed the free use of the Library for a period not exceeding three months without fee. At the discretion of the Director, a deposit may be required when books are issued.

The Eckley B. Coxe Memorial Library

In memory of Eckley B. Coxe, who was for many years a Trustee of the University and who was profoundly interested in its welfare, Mrs. Coxe presented to the University his technical library, consisting of 7727 volumes, together with 3429 pamphlets. As the working library of a man who was remarkable as well for the breadth of his culture as for the extent and thoroughness of his acquaintance with the whole field of applied science, this addition to the resources of the University possesses the greatest value for all professional students.

TAYLOR HALL

Taylor Hall, the gift of Mr. Andrew Carnegie, is a commodious concrete dormitory situated in the University Park, south of Packer Hall. It accommodates about 140 students. There are suites of three rooms, (a study and two adjacent bed rooms,) for

two occupants, and a few single rooms. The building was named Taylor Hall by Mr. Carnegie in honor of Mr. Chas. L. Taylor, his former partner in business, a graduate of the University in the Class of 1876 and a Trustee of the University. The rates for the suites of rooms are $81 a year for each occupant. The single rooms are $65 a year.

PRICE HALL

Price Hall furnishes dormitory accommodations for thirty-four students. It is named in honor of Dr. Henry R. Price, an alumnus of the University of the Class of 1870, President of the Board of Trustees.

Applications for rooms in the dormitories should be filed with the Bursar.

DROWN MEMORIAL HALL

Drown Memorial Hall is a memorial to the late Thomas Messinger Drown, LL.D., President of the University from 1895 to 1904. The building was erected by his friends and the alumni of the University and is devoted to the social interests of the University students. It contains study, reading, conversation, and chess rooms, an assembly hall, and the offices of the Alumni Association, the Young Men's Christian Association, the college publications, the dramatic and musical organizations. It also accommodates the Supply Bureau, conducted by the University, the purpose of which is to furnish books, stationery and supplies to the students at reasonable prices. The profits of the Supply Bureau are applied to the upkeep of Drown Memorial Hall.

The office of the Bursar is in Drown Memorial Hall.

THE COLLEGE COMMONS

The Commons was erected in 1907 to furnish a place where students might obtain wholesome food at cost. There are accommodations for four hundred students. The present rates for table board are $25 for thirty consecutive days, or $7 for a single week.

TAYLOR GYMNASIUM

In 1913 Mr. Chas. L. Taylor, a graduate of the University of the Class of 1876 and a member of the Board of Trustees, donated to the University the funds required for the erection of a gymnasium and a field house.

Taylor Gymnasium is located at the extreme east end of the grounds of the University, adjoining the athletic field. The building is 222 feet long by 73 feet wide. On the ground floor at the north end is located the game-room, 93 by 70 feet, used for basketball and wrestling. The game-room is surrounded by a gallery for spectators. The main gymnasium floor measures 90 by 70 feet. Other rooms in Taylor Gymnasium are the offices and measuring room of the Department of Physical Education, a large trophy room, basketball and handball courts, fencing, boxing and wrestling rooms, and locker rooms with accommodations for the entire student-body.

The gymnasium is equipped with all modern appliances for recreative and corrective exercises, also with apparatus for calisthenic and other gymnastics, both for individual and for class work.

In addition to numerous hot and cold shower baths, adjoining the locker rooms, is a swiming pool, 75 by 25 feet, with a depth from 4½ to 9½ feet. The capacity of the swimming pool is 95,000 gallons.

TAYLOR FIELD

An athletic field of over nine acres in area is provided by the University for the accommodation of students who participate in the various outdoor sports. The Stadium is located on the north side, or lower level, and provides football and baseball fields. It is surrounded by concrete stands having a seating capacity for more than 12,000 spectators. On the upper level are provided practice fields for football, baseball, lacrosse and soccer, also a quarter mile track and a 220-yard straightaway, furnishing ample room for exercise by the entire student-body. During the winter months a wooden outdoor running track, twelve laps to the mile, is provided.

A cage with 60 by 120 feet floor space is provided for indoor baseball, lacrosse, and track and field sports practice.

All athletic sports are under the direction and oversight of the Professor of Physical Education, who is aided by an Athletic Committee composed of alumni and students, members of the Faculty, a member of the Board of Trustees, and the President of the University.

SAYRE PARK

A development of the mountain side of the University grounds was effected through the donation to the University in 1900 of the sum of $100,000 by the children of the late Robert H. Sayre to be applied and used in the development of Sayre Park as a memorial to their father. Mr. Sayre was a Trustee of the University from its foundation in 1866 to his death in 1907. He acted for years as President of the Board of Trustees, and as Chairman of the Executive Committee of the Board, and his services to Lehigh were constant and great.

THE ARBORETUM

The Arboretum, a tract of about eleven acres added in 1909 to the upper end of Sayre Park, was established by a lover of Forestry and a friend of the University as a tree nursery for the purpose of furnishing illustrative specimens of American trees, and of cultivating trees and shrubs for the beautifying of the Park. All of the more important species of North American trees are to be found in the University Park and the Arboretum. Adjoining the Aboretum a tract of seven acres has been planted with a variety of indigenous trees as an exhibition growth of tree culture.

THE UNIVERSITY MUSEUMS

The University Museums include large collections illustrating various branches of Chemistry, Metallurgy, Geology, Mineralogy, Zoölogy and Archæology.

The Metallurgical Cabinet includes specimens illustrating the various processes for obtaining the more common metals.

The Zoölogical collections include the Packer collection of recent shells and the Werner collection of American birds. The latter contains over three hundred and fifty species. In most cases, in addition to the adults, specimens in different plumages as well as the nests and eggs are represented.

The Geological and Mineralogical Museums are located in the west end of Williams Hall, and contain the Roepper and Keim mineral collections, collections of fossils, specimens of ore from mining districts, and extensive series of rocks which illustrate the type occurrences in different parts of the world.

The Cummings Archæological Cabinet has three thousand specimens and includes Dr. Stubb's collection of Indian relics, weapons and utensils.

UNIVERSITY LECTURES

From time to time during the University year, distinguished men are invited to lecture before the students upon those special subjects to which they have given particular attention and upon which they are authorities.

HONORARY SCHOLARSHIP SOCIETIES

PHI BETA KAPPA. Students in the College of Arts and Science and the College of Business Administration who up to the middle of the Senior year maintain high scholarship may be elected to membership, also a limited number of technical students whose work in philosophical, scientific, and language studies is of high grade.

TAU BETA PI. Students in the College of Engineering who up to the middle of the Junior year maintain high scholarship may be elected to membership.

SOCIETIES OF THE COLLEGE OF ENGINEERING

An adjunct of value in promoting professional spirit in the College of Engineering is furnished by the departmental societies, —volunteer organizations of students who meet monthly to present papers, to discuss engineering topics and, from time to time, to hear addresses by invited engineers and scientists of note.

The first of these organizations historically was the Chemical Society, organized in 1871. The original Engineering Society, open to all technical students of the University, was started in 1872. From 1885 to 1899 it issued quarterly numbers of *The Journal of the Engineering Society of Lehigh University*, containing contributions by members, alumni and others. Many of the papers read before this Society from 1890 to 1893 were published in the *Lehigh Quarterly* of those years.

Independent societies were formed in 1900 by students in the Departments of Civil Engineering and Mechanical Engineering. The Electrical Engineering Society, founded in 1887, was reorganized in 1901. The Mining and Geological Society began in 1904, the Metallurgical Society in 1917.

THE ARTS AND SCIENCE CLUB

The Arts and Science Club is the student society of the College of Arts and Science. It was founded in 1905, with the aim of promoting literary and cultural interests in the University.

Students in all courses are eligible for membership. The programs of meetings include papers by members, discussions led by teachers in the College, and occasional talks by scholars from other institutions.

THE Y.M.C.A. OF THE UNIVERSITY

The Christian Association is a voluntary organization of the students for the promotion of the religious, moral, and social life of the University. It was organized April 18, 1890, and on October 11, 1890, united itself with the Intercollegiate Young Men's Christian Association. The movement is distinctly for and by students, all the officers, with the exception of the General Secretary, being chosen from the student-body. The General Secretary is J. Mark Frey, whose office is in Drown Memorial Hall.

PUBLIC WORSHIP

Morning prayers are held in Packer Memorial Church at 7:45 a.m. on every week day except Saturday. Attendance of students is required.

FOUNDER'S DAY

On the first Saturday of October of each year, Commemorative Exercises are held in honor of the Founder of the University. On Saturday, October 4, 1919, the fortieth Founder's Day was celebrated. The oration of the day was delivered by Dr. Natt M. Emery, Vice-President of Lehigh University.

UNIVERSITY SUNDAY

The University sermon is preached on the Sunday before University Day. The Rt. Rev. Ethelbert Talbot, D.D., LL.D., Bishop of Bethlehem, was the preacher on Sunday, June 29, 1919, in the Packer Memorial Church.

HONOR SYSTEM

The Honor System is in force at Lehigh University, having been adopted by the unanimous action of the student-body.

GRADUATING THESES

Theses, when required, are accompanied by drawings and diagrams, whenever the subjects need such illustration. The originals are kept by the University, as a part of the students' record, for future reference, But copies may be retained by students, and be published, permission being first obtained from the Faculty.

UNIVERSITY DAY

University Day is the close of the collegiate year. On this day graduation exercises are held at which an address is given by a representative of the Alumni Association, prizes and honors are awarded, and degrees are conferred.

The program of the exercises on June 28, 1919 was as follows:

MUSIC

PRAYER

ALUMNI ADDRESS

WALTER R. OKESON, C.E., '96

ANNOUNCEMENT OF PRIZES AND HONORS

The Wilbur Scholarship of $200,

SMIE KWEI CHOU, of Hupeh, China.

First in rank in the Sophomore Class.

The John B. Carson Prize of $50 for the best thesis in the Civil Engineering Department,

RALPH FRANKLIN JOHNSON, of Washington, D. C.

The Alumni Prizes of $25, for first honor men in the Junior Class in various departments,

Metallurgy and Mining Engineering,

WILBUR REINOEHL HECK, of Ocean Grove, N. J.

Electrical Engineering,

JOSEPH HERMAN, of Northampton.

The Wilbur Prizes of $10 for excellence in the studies of the Sophomore year,

In Mathematics,

SAMUEL LOUIS FLOM, of Northampton.

In English,

CARL RICHARD BERNER, of Pottsville.

In Physics,

HARRY GUSTAV LARSON, of Limestone, N. Y.

The Wilbur Prizes of $15 and $10, for excellence in the studies of the Freshman year,

In Mathematics,
First: Edwin Louis Reynolds, of Bethesda, Md.
Second: George Frederick Adelbert Stutz, of Washington, D. C.
In English,
Ernest Paul Gangewere, of Chattanooga, Tenn.
In German,
Robert Lee Lerch, of Takoma Park, D. C.
In French,
John Winebrenner Horine, jr., of Columbia, S. C.

SENIOR HONORS

College of Arts and Science,
First: Harold Sprague Hiller, of Buchanan, Mich.
Second: Edwin Adams Hartney, of Allentown.
College of Business Administration,
First: Raymond Woodruff Ludlow, of Keansburg, N. J.
College of Engineering,
Civil Engineering Course,
First: Otto Henry Spillman, of Bethlehem.
Second: Ralph Franklin Johnson, of Washington, D. C.
Mechanical Engineering Course,
First: Levi Roy Lewis, of Clarks Summit.
Second: Anson Wolfinger DeVout, of Harrisburg.
Metallurgical and Mining Engineering Courses:
First: Hsiung Tsai, of Chekiang, China.
Electrical Engineering Course,
First: Edward Thomas Petrik, of Baltimore, Md.
Second: Hempstead Stratton Bull, of Fairbury, Ill.
Chemistry and Chemical Engineering Courses,
First: Howard David Ginder, of Scranton.
Second: Fred Henry Hesselschwerdt, of Buffalo, N. Y.

JUNIOR HONORS

College of Engineering,
Mechanical Engineering Course,
First: Robert Joseph Ott, of Bethlehem.
Metallurgical and Mining Engineering Courses,
First: Wilbur Reinoehl Heck, of Ocean Grove, N. J.
Second: August Max Kuhlmann, of Washington, D. C.

Electrical Engineering Course,
First: JOSEPH HERMAN, of Northampton.
Second: DARCY MATTHEW GEORGE, of Nazareth.

SOPHOMORE HONORS

In Mathematics,
First: SMIE KWEI CHOU, of Hupeh, China.
Second: SAMUEL LOUIS FLOM, of Northampton.

In English,
First: CARL RICHARD BERNER, of Pottsville,
Second: LEROY FISHER CHRISTMAN, of Womelsdorf.

In Physics,
First: HARRY GUSTAV LARSON, of Limestone, N. Y.
Second: JOHN HERBERT ALDEN, of Washington, D. C.

FRESHMAN HONORS

In Mathematics,
First: EDWIN LOUIS REYNOLDS, of Bethesda, Md.
Second: GEORGE FREDERICK ADELBERT STUTZ, JR., Washington, D. C.

In English,
ERNEST PAUL GANGEWERE, of Chattanooga, Tenn.

In German,
ROBERT LEE LERCH, of Takoma Park, D. C.

In French,
JOHN WINEBRENNER HORINE, of Columbia, S. C.

Degrees in course were then conferred by the President of the University as follows:

MASTER OF ARTS

ROBERT CHARLES KING, B.A.,
(*University of Missouri*), Bethlehem.

ALEXANDER MOSES LINDSAY, B.A.,
(*Lebanon Valley College*), Harrisburg.

GUSTAVUS EUGENE OSWALD, B.A.,
(*Ursinus College*), Catasauqua.

HARRY C. SNYDER, PH.B.,
(*Muhlenberg College*), Emaus.

JOHN MILTON TOOHY, B.A.,
(*Lehigh University*), Bethlehem.

MASTER OF SCIENCE

William Lane De Baufre, E.E., M.E., (*Lehigh University*),	Baltimore, Md.
Parke Benjamin Fraim, E.M., (*Lehigh University*),	Bethlehem.
Robert Thomas Hutchinson, B.S., (*Muhlenberg College*),	Bethlehem.

BACHELOR OF ARTS

Charles Joseph Brockman,	Nazareth.
Edwin Adams Hartney,	Allentown.
Alfred Carl Haussmann,	Fox Chase.
Harold Sprauge Hiller,	Buchanan, Mich.
William Vincent McCarthy, jr.,	Springfield, Mass.
William Bradley McKinley,	Olyphant.
William Lafayette Raeder, '76,	Scranton.
James David Sourber,	Pottsville.
Harold Rodman Walters,	Bethlehem.
Theodore Cyril Zeller,	McKeesport.

BACHELOR OF SCIENCE

Kenneth Miller Bevier,	Brooklyn, N. Y.
Roy Riddell Coffin,	Germantown.
Lloyd Carroll Fenstermacher,	Reading.
Raymond Woodruff Ludlow,	Keansburg, N. J.
Donald MacIsaac,	Richmond Hill, N. Y.
Philip Lawrence McGrath,	West Roxbury, Mass.
Milton Augustus Manley,	Brooklyn, N. Y.
Thomas Stanley Pengelly,	Hazleton.

CIVIL ENGINEER

Curtis Buttz Gorisse,	Lebanon, N. J.
Edgar Henry Iobst,	Emaus.
Ralph Franklin Johnson,	Washington, D. C.
James Knox Lees, B.A., (*Lehigh University*),	Bethlehem.
Benjamin Haines Rigg,	Burlington, N. J.
Otto Henry Spillman,	Bethlehem.
George Esch Weber,	Ardmore, Okla.

MECHANICAL ENGINEER

Walter Park Amick,	Philadelphia.
Carl John Cardin,	North Brookfield, Mass.
Anson Wolfinger De Vout,	Harrisburg.
Wilbur Frederick Diefenderfer,	Allentown.
David Dorkin,	Bridgeport, Conn.
Doron Dosch,	Elizabeth, N. J.
Beeton Pullman Lauder,	Bridgeport, Conn.
Levi Roy Lewis,	Clarks Summit.
Charles Dorney Mertz,	Frackville.
Samuel Thomas Mitman,	Bethlehem.
Andrew John Nicholas,	Bethlehem.
Nelson Roy Reynolds,	Bethlehem.
Ellwood Montgomery Rowand, jr.,	Haddon Heights, N. J.
Charles Hoyt Tomkinson,	Plainfield, N. J.
Edgar Fritz Wait,	Bethlehem.
Samuel Hancock Webb,	Jamaica, N. Y.
Edward Foote Whitney,	Sherburne, N. Y.

METALLURGICAL ENGINEER

To Shuen Sun,	Anhui, China.
Yasuo Takikawa,	Tokyofu, Japan.

ELECTROMETALLURGIST

Frederic George Sefing,	Allentown.
Walter Ray Woolley,	Asbury Park, N. J.

ENGINEER OF MINES

Baltasar Botero,	Sanson, Colombia.
Albert Anthony Korves,	Bethlehem.
Arnobio Bernardo Mora,	Loja, Ecuador
Thomas Carson O'Neill, jr.,	Altoona.
Hsiung Tsai,	Huchow, Chekiang, China.
Stratton Vance,	Port Washington, N. Y.

ELECTRICAL ENGINEER

Hempstead Stratton Bull,	Fairbury, Ill.
Gordon Franklin Jones,	Irwin.
José Antonio Oritz,	Santiago, Cuba.
Edward Thomas Petrik,	Baltimore, Md.

CHEMICAL ENGINEER

Lewis Albert Baumann,	Washington, D. C
Gilbert Everett Doan,	Lansdale.
Joseph Wilkins Gardiner, jr.,	Philadelphia.
Ivan Preston Gerber,	York.
Howard David Ginder,	Scranton.
Fred Henry Hesselschwerdt,	Buffalo, N. Y.
Morris Lawrence,	Scranton.
Lawrence DeWitt Lytle,	California.
Augustus Greth Mayers,	Reading.
Franklin Baily Speakman,	Strathmere, N. J.

SCHOLARSHIPS, FELLOWSHIPS, AND PRIZES

THE WILBUR SCHOLARSHIP

The Wilbur Scholarship was founded in 1872 by the late E. P. Wilbur and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

THE HARRY S. HAINES MEMORIAL SCHOLARSHIP

Mrs. Henry S. Haines, of Savannah, Georgia, established in 1889 a scholarship of the annual value of $200 as a memorial to her son, Henry Stevens Haines, M.E., a member of the Class of 1887. This scholarship is devoted to the support at Lehigh University, throughout his scholastic career, of one student in the Course of Mechanical Engineering.

THE FRED. MERCUR MEMORIAL FUND SCHOLARSHIPS

Friends of the late Frederick Mercur, of Wilkes-Barre, Pennsylvania, General Manager of the Lehigh Valley Coal Company, desiring to establish a memorial of their friendship and esteem, and to perpetuate his memory, contributed and placed in the hands of the Trustees a fund called "The Fred. Mercur Memorial Fund," sufficient in amount to insure the award of three scholarships for free tuition in the University.

THE JOSEPH MANN PRICKITT SCHOLARSHIP

Mr. and Mrs. Cooper H. Prickitt, of Burlington, N. J., established, in April, 1919, a scholarship, to be known as the Joseph Mann Prickitt Scholarship, in memory of their son, Joseph Mann Prickitt, of the Class of 1917, who died on March 10, 1916.

This scholarship is of sufficient amount to cover expenses for tuition, fees and books. It is the expressed wish of the donors that the scholarship be awarded to graduates of the Burlington, N. J., High School on the nomination of the Principal of that school, subject to the approval of the President of the University, or in case of no nomination from that school that the award be made to deserving students from other localities.

THE ECKLEY B. COXE MEMORIAL FUND

In memory of the late Eckley B. Coxe, Trustee of the University, Mrs. Coxe has established a fund, amounting to $30,000, the interest of which is used, under the direction of the Trustees of the University, and subject to such regulations as they may adopt, for the assistance of worthy students requiring financial aid.

THE FRANK WILLIAMS FUND

Frank Williams, E.M., of Johnstown, Pennsylvania, a graduate of the course in Mining and Metallurgy of the Class of 1887, who died October, 1900, bequeathed to the University the greater part of his estate, now amounting to over $120,000, to found a fund, the income of which is lent to deserving students. At present the larger part of this income is devoted to certain life tenants under Mr. Williams' will. After their death the entire income will be available.

THE DU PONT FELLOWSHIP

In June, 1918, E. I. duPont de Nemours and Company, for the purpose of encouraging the study of Chemistry, offered an annual scholarship of $350 to be awarded to a senior student or graduate student in the Department of Chemistry and Chemical Engineering. For the collegiate year, 1919-1920, the amount was increased to $750 for the establishment of a fellowship.

THE GEORGE D. CALLENDER FELLOWSHIP

The George D. Callender Fellowship for the promotion of research in chemistry is a gift of $1500 for the collegiate year, 1919-1920, bestowed by an anonymous friend of the late George D. Callender, a chemist who died in Chicago in 1914 while associated with the donor of the scholarship. Mr. Callender was born in Linlithgow, Scotland, and was graduated from the chemistry department of Glasgow University.

WILBUR PRIZES

A fund was established by the late E. P. Wilbur for distribution in prizes as the Faculty shall determine. This fund yields an annual income of $100.

THE PRICE PRIZE FOR ENGLISH COMPOSITION

Dr. Henry R. Price, an alumnus and Trustee of the University, established in 1898 an annual prize of the value of $25, to be awarded in June to that member of the Freshman Class who shall write the best essay on a topic in English Literature assigned by the head of the Department of English not later than the beginning of the second term in each year.

In estimating the value of essays submitted, the greatest stress will be laid upon clearness of thought and force of expression.

Students must signify in writing their intention of competing not later than the first of April.

The subject for the prize essay in June, 1920, will be: "Literature in Virginia, 1607-1700."

THE JOHN B. CARSON PRIZE

An annual prize of $50 was established in 1909 by Mrs. Helen C. Turner, of Philadelphia, Pennsylvania, in memory of her father, John B. Carson, whose son, James D. Carson, was a graduate of the Civil Engineering Department of Lehigh University in 1876. It is awarded for the best thesis in the Civil Engineering Department.

THE ALUMNI ASSOCIATION

The Alumni Association, which has been in existence since 1876, was incorporated in 1917 under the name The Alumni Association of the Lehigh University, Inc. The Alumni Secretary, who devotes all of his time to Association affairs, is Walter R. Okeson, '96, whose offices are in Drown Memorial Hall. Mr. Okeson edits the *Lehigh Alumni Bulletin*, a quarterly news publication, and the *Alumni and Student List*. An appointment bureau is maintained by the Association.

The officers of the Alumni Association for 1919-20 are:

President, Charles D. Marshall, '88, of Pittsburgh.
Vice-President, Aubrey Weymouth, '94, of New York.
Vice-President, William W. Coleman, '95, of Milwaukee, Wis.

Treasurer, Alan C. Dodson, '00, of Bethlehem.
Secretary, Walter R. Okeson, '96, of Bethlehem.
Archivist, Preston A. Lambert, '83, of Bethlehem.

Honorary Alumni Trustees, Robert S. Perry, '88, of New York; Franklin Baker, Jr., '95, of Philadelphia; Henry H. Scovil, '00, of Pittsburgh, and Homer D. Williams, '87, of Pittsburgh.

The following are the local alumni clubs: New York Lehigh Club, Philadelphia Lehigh Club, Pittsburgh Lehigh Club, Chicago Lehigh Club, Washington Lehigh Club, Detroit Lehigh Club, Northeastern Pennsylvania Lehigh Club (Scranton and Wilkes-Barre), Maryland Lehigh Club (Baltimore), Lehigh Club of New England (Boston), Intermountain Lehigh Club (Salt Lake City, Utah), Lehigh Club of Central Pennsylvania (Harrisburg), Lehigh Club of Northern New York (Schenectady), Lehigh Club of Northern Ohio (Cleveland), Lehigh Club of Southern New England (Hartford), Lehigh Club of Western New York (Buffalo), Southern Anthracite Lehigh Club (Pottsville), Southwestern Lehigh Club (St. Louis), Lehigh Home Club (Bethlehem), Lehigh Club of China (Wuchang), Lehigh Club of Cuba (Havana).

ALUMNI PRIZES

By a resolution of the Alumni Association of September 21, 1900, the Alumni Scholarship Fund, which was originally designed to help poor students, was with the consent of the contributors diverted from this purpose and the income devoted to prizes to members of the Junior Class. In June, 1920, two prizes of $25 each will be awarded to the first honor men of the courses in Chemistry and Chemical Engineering and of the course in Civil Engineering. In subsequent years the prizes will be awarded to the first honor men of the other technical courses in turn.

ALUMNI PRIZES FOR ORATORY

The Alumni Association of Lehigh University established in 1882 annual prizes for excellence in oratory, amounting to $50.

Regulations

1. The contest shall be held on the 22nd day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second prize of $15, and a third prize of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the orations shall be announced at the beginning of the first term of every year, and upon one of these each competitor shall write an oration not to exceed 1200 words, taking about eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do—should they be sufficient in number—the best six shall be chosen and their envelopes opened. The others shall be returned to the addresses given with their envelopes unopened.

6. The Executive Committee of the Alumni Asociation, or a committee of not fewer than three to be appointed by them, shall hear the competitors whose orations shall have been approved, and the awards shall be made by a majority of these judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

The annual contest in Oratory for the Alumni Prizes was held on March 1, 1919, with the following competitors:

Robert Schwartz Cope, of Bethlehem.
Norman Cyrus Dittes, of Reading.
Howard Greenwald Sommers, of Allentown.
Mercer Brown Tate, Jr., of Harrisburg.

The first prize was awarded to Mr. Dittes, the second to Mr. Tate, and the third to Mr. Sommers. A fourth special prize was awarded to Mr. Cope.

The Judges were Dr. Albert G. Rau, '88; Mr. Alvin S. Gruver and the Rev. James Robinson.

WILLIAMS PRIZES IN ENGLISH

Professor Edward H. Williams, jr., an alumnus of the University, a graduate of the Class of 1875, established in February, 1900, prizes amounting annually to three hundred and thirty-five dollars for excellence in English Composition and Oratory. The conditions of the endowment are as follows:

Sophomore Composition Prizes

1. At the beginning of each term the Sophomore Class shall be divided into two sections alphabetically and to that student in each section who, at the end of a term, and of each term, shall receive the highest rank in English Composition during that term shall be awarded the "First Sophomore Composition Prize" of ten dollars, and to that student in each section as aforesaid who shall receive the next highest rank in the same subject shall be awarded the "Second Sophomore Composition Prize" of five dollars. In each year there will be offered four first and four second prizes—a total of sixty dollars.

If more than one student shall receive the highest rank in any section, the amount of the two prizes shall be added together and the sum—fifteen dollars—shall be equally divided between them, and no second prize shall be offered in that section. If more than one student shall receive the next highest rank in any section when there is but one contestant for the first prize, the second prize shall be equally divided between the two having the second rank.

Senior Premiums

2. The Faculty shall publish within one month of the end of the University year a list of subjects for dissertations, selected from English Literature and Economics, entitled Subjects for Senior Premiums. To this list shall be appended a date near the first of January following—to be determined upon by the Faculty —when the contest shall be declared closed and the dissertations shall become due.

From the above list any member of the Senior Class may select a subject and write thereon a dissertation, whose length shall be prescribed by the Faculty, and shall send the same anonymously, but marked for identification, as the Faculty may direct, to the Secretary of the Faculty before the date aforesaid.

The Faculty, or its committee, shall meet on the above date and at subsequent adjourned meetings, and, first, having determined upon a standard of excellence which each and all dissertations must reach in order to be admitted to the following competition, shall examine the dissertations submitted to them and admit those which reach the above standard. In case none are up to the standard, and are admitted they shall declare the contest closed for that year, and no prizes shall be awarded.

If one or more dissertations are admitted as aforesaid, the Faculty, or its committee, shall arrange them in the order of their literary merit and soundness of their reasoning, and the six highest in this arrangement shall be retained and all others returned as directed by the writers, who shall remain unknown. The names of the successful writers shall be ascertained and they shall be required to recast their dissertations in the form of an oration, and to speak the same in public at such time during the Commencement Week as the Faculty shall determine.

The Faculty, or its committee, shall be the judges of excellence in the speaking, and shall award to that Senior student who shall speak his oration in the best manner, the Senior Gold Medal, of the value of one hundred dollars, or, at his option, one hundred dollars in gold. They shall award to the other five speakers the five Senior Premiums of ten dollars each.

Graduate Prize

3. At the end of the University year, during Commencement Week, the Faculty shall publish a second list of subjects for theses selected from English Literature, Economics, Mental and Moral Science, and similar subjects which require thought and application, and which must be of such a character that their mastery shall be accomplished only through considerable research and study.

From this list any member of the class just graduating; the Senior Class of the coming University year; a graduate of one year's standing whether in or out of residence, and a graduate of any class who may be, during the coming year, in actual residence and taking post-graduate work in the University, may select a subject and write thereon a thesis of not less than five thousand words and send the same to the Secretary of the Faculty, anonymously, but marked for identification as the Faculty may designate, before the date, which the Faculty shall select within one

month before the next Commencement, and which date must appear on the above list.

The Faculty, or its committee, shall meet on this date, and at adjourned meetings thereafter, and, having first established a standard of excellence, which must, first, be a high one, and second, shall require on the part of the competitor ability in the plan, development, argument, and conclusion of the work, as well as literary merit in its composition and presentation, shall admit to the following competition only those who fully attain to the above required standard.

If none of the theses submitted shall have attained to the standard aforesaid, the competition shall be declared closed and the prize shall not be awarded.

To the author of that thesis which shall have been admitted to the competition, and which shall have been declared of the highest excellence, the Graduate Prize of one hundred and twenty-five dollars shall be awarded and presented on Commencement Day with the other prizes and awards of that day.

The successful thesis shall be the property of the University, but the author shall be allowed to retain one copy. Publication of the thesis by the author will only be permitted by vote of the Faculty. Such publication must, however, be entitled Graduate Prize Thesis of the Lehigh University.

The winner of a prize shall not be allowed to compete again.

Professor Williams has directed that the income derived from the endowment for the Williams Prizes shall be applied and used as follows:

1. All portions of said income remaining after the payment of all prizes awarded in any one year, shall be invested and added to the principal of said endowment.

2. If any prize shall, for any reason, be not awarded in any year, the sum thus unpaid shall be invested and added to the said principal.

3. If for any reason the amount of the income from said endowment shall fall below the total sum necessary to pay said prizes, the amounts of the individual prizes shall be proportionally reduced till their sum shall be equal to three-fourths of the said reduced income, and this three-fourths shall be used to pay them; the remaining one-fourth is to be invested and added to the said principal.

4. This investment of residues, as above said, shall continue till the principal of said endowment shall be sufficiently large to furnish an income at two per cent. interest, which will be sufficient to pay all said prizes now established.

5. When said principal shall be large enough to furnish the necessary sum to defray the said prizes, as stated in No. 4, the surplus income remaining after paying all the prizes awarded during the year shall be used by the President of the University to encourage oratory, debate, or any other object decided upon by the Faculty.

THE FRAZIER AND RINGER MEMORIAL FUND

This is a fund for the medical and surgical care of needy students, established in memory of Benjamin West Frazier, A.M., Sc.D., formerly Professor of Mineralogy and Metallurgy, and Severin Ringer, U.J.D., formerly Professor of Modern Languages and Literatures and of History, each of whom faithfully served Lehigh University for one-third of a century. The fund was started February 12, 1906, by the donation of thirteen thousand dollars by the late Robert H. Sayre. It is the hope and expectation of the friends of the University that this fund may, by other donations, be increased in time to amount to a sum sufficient to insure free medical and surgical attendance to all students of the University requiring such aid.

STUDENTS

B.A—Bachelor of Arts.
Bus.—Business Administration.
C.E.—Civil Engineering.
Ch.E.—Chemical Engineering.
Chem.—Chemistry.
E.E.—Electrical Engineering.
E.M.—Mining Engineering.
El.Met.—Electrometallurgy.
M.E.—Mechanical Engineering.
Met.—Metallurgy.
N.E.—Ship Construction and Marine Transportation.

GRADUATE STUDENTS

The names in the following lists include all the students who have registered and attended recitations at the University for the current year.

	For Degree	Residence
Appel, Howard Frederick, Met., (*Lehigh University.*)	M.S.,	Everett.
Barthold, William Gregory, B.A., (*Lehigh University.*)	M.A.,	Bethlehem.
Bauman, John Edmiston, A.B., C.E., (*Lehigh University.*)	M.S.,	Allentown.
Beaver, Jacob Lynford, E.E., (*Lehigh University.*)	M.S.,	Bethlehem.
Beck, George Carlton, A.C., (*Lehigh University.*)	M.S.	Bethlehem.
Boston, Henry Robert, B.S., C.E., (*College of City of New York, Lehigh University.*)	M.S.	New York, N. Y.
Buck, Leonard Jerome, E.M., (*Lehigh University.*)	M.S.,	Bethlehem.
Burke, James Michael, B.S., (*Lehigh University.*)	M.S.,	Akron, Ohio.
Callen, Arthur Spencer, El.Met., (*Lehigh University.*)	M.S.,	Florence, Ala.
Chamberlin, Dale S., Ch.E., (*University of Michigan.*)	M.S.,	Bethlehem.
Clemmitt, Willis Butler, E.M., (*Lehigh University.*)	M.S.,	Chicago, Ill.
Crowley, Henry L., B.S., M.E., (*College of City of New York, Stevens Institute of Technology.*)	M.S.,	Indian Head, Md.

De Lozier, Arthur L., B.A., M.A., Allentown.
(*Ashland College.*)

Diefenderfer, Herbert H., B.S., M.S., South Amboy, N. J.
(*Pennsylvania State College.*)

Doan, Gilbert Everett, Ch.E., M.S., Annapolis, Md.
(*Lehigh University.*)

Eshbach, Ovid Wallace, E.E., M.S., Bethlehem.
(*Lehigh University.*)

Everhart, William Alfred, B.A., M.S. Bethlehem.
(*Miami University.*)

Fegely, Solon J., A.B., M.A., Allentown.
(*Lafayette College.*)

Floyd, Harold Alan, Met.E., M.S., New York, N. Y.
(*Lehigh University.*)

Glasier, J. Arthur, B.D., M.A., Bethlehem.
(*General Theological Seminary.*)

Grubb, Percy Lamar, B.A., M.A., Harrisburg.
(*Lehigh University.*)

Ham, Frank Mapes, B.S., M.S., Bethlehem.
(*Wesleyan University.*)

Hartzell, Allen Reiff, B.S., M.S., Bethlehem.
(*Franklin and Marshall College.*)

Haussmann, Alfred Carl, B.A., M.A., Fox Chase.
(*Lehigh University.*)

Higgins, Emerson Corson, jr., M.S., Tulsa, Okla.
B.S., (*Lehigh University.*)

Hoch, Helena M., B.A., M.A., Bethlehem.
(*Moravian College for Women.*)

Hutchinson, Robert Thomas, M.S., Bethlehem.
B.S., (*Muhlenberg College.*)

Ischinger, Robert, H., B.D., M.A., Allentown.
(*Mt. Airy Lutheran Theological Seminary.*)

Jacobosky, Gilbert Garfield, C.E., M.S., Wilkes-Barre.
(*Lehigh University.*)

Jacobs, Homer Miller, Ph.B., M.A., Easton.
(*Lafayette College.*)

Kamura, Heihachi, Met.E., M.S., Saga, Japan.
(*Meiji College of Technology, Japan.*)

Linn, Tsin I., E.M., M.S., Lansford.
(*Lehigh University.*)

Lottenville, Marie, A.B., M.A., Bethlehem.
(*Indiana State University.*)
Lu, Chang-Chih, E.E., M.S., Canton, China.
(*Lehigh University.*)
McCullough, Harry Rath, A.B., M.A., Allentown.
(*Muhlenberg College.*)
Marcks, Frederick Augustus, M.A., Nazareth.
B.A., (*Muhlenberg College.*)
Martin, Robert Earl, A.B., M.S., Bethlehem.
(*University of Indiana.*)
Murai, Ichiro, B.S., M.S., Port Arthur, China.
(*Tokyo Imperial University.*)
Oswald, Gustavus Eugene, B.A., M.A., Catasauqua.
(*Ursinus College.*)
Rex, Barron P., Ph.B., M.S., Bethlehem.
(*Lafayette College.*)
Ringleben, August A., A.B., M.A., Hazleton.
(*Ursinus College.*)
Schumaker, John G., A.B., M.A., Allentown.
(*Muhlenberg College.*)
Schwaninger, Mary Alice, A.B., M.A., Allentown.
(*Western Maryland College.*)
Sheaffer, Ira Lee, B.S., M.S. Northampton.
(*Muhlenberg College.*)
Shafer, Bentley Sayre, B.A., M.A., Asheville, N. C.
(*Lehigh University.*)
Shedd, Thomas C., Sc.B., M.S., Phoenixville.
(*Brown University.*)
Smull, Judson Gray, M.S., Bethlehem.
B.S. (in Chem.) (*Lehigh University.*)
(George D. Callender Fellow in Chemistry.)
Sourber, James David, B.A., M.A., Catasauqua.
(*Lehigh University.*)
Strunk, Elvira M., B.S., M.S., Changsha, Hunan, China.
(*Albright College.*)
Taylor, Robert Norman, Ph.B., M.S., Bethlehem.
(*Muhlenberg College.*)
Urich, Robert R., B.A., M.A., Nazareth.
(*Muhlenberg College.*)
Vincente, Manuel Lucas, C.E., M.S., Mayaguez, P. R.
(*Lehigh University.*)

Ward, Arthur Thomas, El.Met., M.S., Bellefonte.
(*Lehigh University.*)
Weirbach, T. Mahlon, A.B., M.A. Allentown.
(*University of Michigan.*)
Wentz, Herbert Homer, B.S., M.S., Allentown.
(*Muhlenberg College.*)
Ziegenfuss, Warren Allen, A.B., M.A., Allentown.
(*Muhlenberg College.*)

Bishop, Jacob Ariel, B.A., M.E., Chambersburg.
(*Lehigh University.*)
Brockman, Charles Joseph, B.A., Ch.E., Nazareth.
(*Lehigh University.*)
Dech, Alan Oplinger, B.A., B.A., Myerstown.
(*Albright College.*)
Duck, Francis John George, B.S., Ch.E., Scranton.
(A) (*St. Thomas College.*)
Huebner, Richard Victor, B.S., Bus., Allentown.
(*Pennsylvania Military College.*)
Lester, Henry Claybrook, B.S., E.M., Martinsville, Va.
(*Virginia Polytechnic Institute.*)
Marsh, Harry Harrison, jr., A.B., E.E., Grafton, W. Va.
(*Marietta College.*)
Porter, Frederick Meredith, B.A., E.E., York.
(*Lehigh University.*)
Shackelford, William Calvin, E.M., Birmingham, Ala.
B.S., (*Virginia Military Institute.*)
Sun, To Shuen, Met., E.M., Show Chow, Anhui, China.
(*Lehigh University.*)
Tait, Watson Fergus, jr., A.B., E.E., Parkersburg, W. Va.
(*Marietta College.*)

Bryant, Carleton Fanton, U.S.N., Spl. Met., Bangor, Me.
(*U. S. Naval Academy.*)
Fisher, Joseph Anton, jr., B.A., Spl. Bus., Bethlehem.
C.E., (*Lehigh University.*)
Sawyer, Edmund Ellis, B.A., Spl. Chem., Hackensack, N. J
(*Amherst College.*)
Spanagel, Herman Adolph, Spl. Met., Canton, Ohio.
U.S.N., (*U. S. Naval Academy.*)

Uihlein, Ralph Alfred, B.Ph., Spl. El.Met., Milwaukee, Wis.
(*Yale University.*)

Wolf, George Wheeler, U.S.N., Spl. Met., Pittsburgh.
(*U. S. Naval Academy.*)

Woodside, Elmer Lee, U.S.N., Spl. Met., St. Joseph, Mo.
(*U. S. Naval Academy.*)

SENIOR CLASS

Class of 1920

	Course	Residence
Allan, Elwood Maxwell,	El.Met.,	Jermyn.
Allgaier, William Raymond,	C.E.,	Philadelphia.
Bachert, Homer Allison,	E.E.,	Bethlehem.
Baderschneider, Engelbert Henry,	M.E.,	Monongahela.
Barefoot, John Sterrett,	C.E.,	Milroy.
Barthol, Preston Clayton,	Bus.,	Bethlehem.
Beard, John,	M.E.,	Germantown.
Beck, William Andrew, Jr.,	B.A.,	Englewood, N. J.
Bell, John Gordon,	Met.,	Canton, O.
Bell, Samuel Kneale,	Ch.E.,	Germantown.
Bellman, Russell Sylvester,	M.E.,	Louisville, Ky.
Bergdoll, John George, Jr.,	M.E.,	York.
Booth, Edwin,	C.E.,	Carbondale.
Brooks, Maxwell Jacobs,	El.Met.,	Niagara Falls, N. Y.
Brown, Robert Emerson,	Met.,	Butler.
Bugbee, Alvin Newton,	C.E.,	Trenton, N. J.
Bunn, Howard Stolpp,	B.A.,	Elkins Park.
Carr, Peter Aloysius,	C.E.,	Freeland.
Carr, William Arthur,	M.E.,	Washington, D. C.
Chapman, Lester Nathaniel,	E.M.,	Wollaston, Mass.
Chen, Chi-fah,	E.M.,	Amoy, China.
Concilio, August,	E.E.,	Newton, N. J.
Cope, Robert Schwartz,	B.A.,	Bethlehem.
Croce, Gennero S. Della,	El.Met.,	Freeland.
Danzer, Russell William Herbert,	M.E.,	Bethlehem.
Davidson, Beale Bordley,	Met.,	Elizabeth, N. J.
Dewhirst, Harold Hodgkins,	C.E.,	Washington, D. C.
Diener, Fred Peter,	Ch.E.,	Allentown.

Dorsam, William Christian,	El.Met.,	Brooklyn, N. Y.
DuBois, Arthur William,	Bus.,	Coudersport.
Eisenhard, Ray Long,	Met.,	Allentown.
Erwin, George Henry,	Ch.E.,	Bethlehem.
Estes, Edward Wynne,	M.E.,	Bethlehem.
Evans, Arthur Randolph,	M.E.,	Freeland.
Ewing, Boyd Ross, Jr.,	B.A.,	Allentown.
Farber, Hobart Amory,	B.A.,	Northampton.
Flory, Clyde Reuben,	B.A.,	Edelman.
Forstall, Edward Logan,	M.E.,	Rosemont.
Ganey, James Cullen,	B.A.,	Bethlehem.
Ganter, George A.,	E.M.,	New York, N. Y.
Gardy, Jacob Allen,	Bus.,	Doylestown.
Geiger, Joseph Lewis,	M.E.,	Scarletts Mills.
George, Darcy Matthew,	E.E.,	Nazareth.
Gilmore, Dale James,	B.A.,	Williamsport.
Glaser, Alfred William,	M.E.,	Baltimore, Md.
Golding, Harold Frederick,	Bus.,	Trenton, N. J.
Greenstein, Philip David,	Ch.E.,	Bridgeport, Conn.
Grubbs, Richard Holmes,	C.E.,	Baltimore, Md.
Hammond, Philip Conrad,	C.E.,	Bridgeport, Conn.
Harwi, Lawrence Hartman,	Bus.,	Bayonne, N. J.
Heck, Wilbur Reinoehl,	E.M.,	Ocean Grove, N. J.
Heffelfinger, Roy Harold,	Chem.,	Palmerton.
Heilman, John Beaver,	El.Met.,	Lebanon.
Heimbach, Eugene Dewey,	M.E.,	Renovo.
Herman, Joseph,	E.E.,	Northampton.
Hills, Philip Randolph,	B.A.,	Mill Hall.
Hoffman, Solomon,	E.E.,	Baltimore, Md.
Hollinshead, Earl Darnell,	E.M.,	Medford, N. J.
Holmes, Joseph Austin, 2nd,	E.M.,	Washington, D. C.
Honeyman, Robert Brodhead,	Met.,	Brooklyn, N. Y.
Hunt, Clarkson Toms,	M.E.,	Lansdowne.
Hunton, William Hoppe,	Ch.E.,	Philadelphia.
Jenness, Edwin Hutchins,	M.E.,	Chicago, Ill.
Karton, Harry,	Ch.E.,	Philadelphia.
Keim, Rollin Reuben,	Ch.E.,	Bethlehem.
Keith, Isham, III,	E.E.,	Warrenton, Va.
Ketcham, Burton Tilden,	B.A.,	Huntington, N. Y.
Knerr, Ralph Johnson,	M.E.,	Claussville.
Knerr, William James,	El.Met.,	Allentown.

Knight, LeRoy Fowler,	E.M.,	Scranton.
Koan, Koam Tsing,	Ch.E.,	Bangkok, Siam.
Kreidler, William Alfred,	B.A.,	Bethlehem.
Kuhlmann, August Max,	El.Met.,	Washington, D. C.
LeRoy, Milton Joseph,	El.Met.,	Syracuse, N. Y.
Leverich, Leonard Phillips,	Bus.,	Brooklyn, N. Y.
Levy, Harry G.,	C.E.,	Hazleton.
LeWine, Oscar Ezra,	C.E.,	Atlantic City, N. J.
Lewis, Randolph Osgood,	M.E.,	Washington, D. C.
Macarow, Frederick Garner,	E.E.,	Hazleton.
Maginnes, William David,	B.A.,	New York, N. Y.
Mathag, Nathan,	E.M.,	New Haven, Conn.
Melville, Cyril Glennon,	C.E.,	Harrisburg.
Memmert, Paul William,	Ch.E.,	Nazareth.
Mersfelder, John Henry, Jr.,	Ch.E.,	Newark, N. J.
Mieldazis, Jerome John,	C.E.,	Shenandoah.
Mooers, Edward Allen,	Ch.E.,	Elmira, N. Y.
Munoz, Audato Laurence Lorenzo,	M.E.,	Santa Barbara, Honduras.
Muth, Edgar Franklin,	M.E.,	Northampton.
Naame, Joseph Shikri,	C.E.,	Atlantic City, N. J.
Nevins, Benjamin Ross,	E.E.,	Tamaqua.
Newell, Norman Albert,	E.E.,	West Hoboken, N. J.
Obert, Joseph Geggus,	Bus.,	Lehighton.
Ott, Robert Joseph,	M.E.,	Bethlehem.
Overton, Sereno Burnell,	M.E.,	Southampton, N. Y.
Paret, Milnor Peck, Jr.,	C.E.,	Lake Charles, La.
Pawlik, Benjamin Adolph,	E.M.,	Union Hill, N. J.
Pons, Nicholas Batista,	M.E.,	Niquero, Cuba.
Randall, Arthur Heckford,	Ch.E.,	Bloomfield, N. J.
Reed, Lawrence Frank,	M.E.,	Orwigsburg.
Reid, Ricklef Allen,	E.E.,	Glen Ridge, N. J.
Reinhardt, Joseph Alfred,	C.E.,	Brooklyn, N. Y.
Rice, Harry Charles,	Ch.E.,	Hazleton.
Rosenmiller, Joseph Lewis,	E.M.,	York.
Ross, Ira George, Jr.,	Bus.,	Mauch Chunk.
Ruf, Leonard Edward,	C.E.,	Philadelphia.
Ruff, Charles Frederick,	C.E.,	Philadelphia.
de Sa, Angelo,	M.E.,	Bahia, Brazil.
Saxman, Harry Suydam,	E.M.,	Latrobe.
Schlasman, William Henry,	M.E.,	Reading.

Schmich, John Emil,	E.E.,	Bethlehem.
Schrader, William Dewey,	E.M.,	Allentown.
Schubert, Charles Samuel,	E.M.,	Roanoke, Va.
Scott, George Stanley,	Ch.E.,	East Mauch Chunk.
Shafer, Alfred Elwood Morton,	M.E.,	Lehighton.
Shirk, William Blottenberger,	E.E.,	Lebanon.
Siegfried, Joseph Albert,	E.E.,	Nazareth.
Smith, Harold DeWitt,	Ch.E.,	Bayonne, N. J.
Smoyer, Lloyd Moser,	E.E.,	Allentown.
Sommers, Howard Greenwald,	Ch.E.,	Allentown.
Spagna, Joseph,	C.E.,	Avon, Mass.
Spalding, Julius Herman,	M.E.,	Pottsville.
Spillman, Arnold Dolder,	El.Met.,	Bethlehem.
Stotz, Edward, Jr.,	C.E.,	Pittsburgh.
Straub, James Moser,	C.E.,	Canonsburg.
Subkow, Philip,	Ch.E.,	Bethlehem.
Sugar, Aaron Jesse,	Ch.E.,	Norfolk, Va.
Tate, Mercer Brown, Jr.,	B.A.,	Harrisburg.
Terry, John Hermon, Jr.,	Ch.E.,	Edgewater Park, N. J.
Terry, Walter Septer,	M.E.,	Holtsville, N. Y.
Thompson, James Stanley,	Ch.E.,	Warehouse Pt., Conn.
Timmons, John Irving,	C.E.,	Snow Hill, Md.
Tinker, Edward Lay,	E.E.,	West Haven, Conn.
Townsend, Stanley Coleman,	E.E.,	Malvern.
Tseng, Yin Lian,	E.M.,	Blinjoe, Banka, Dutch East Indies.
Wagener, August Hans,	C.E.,	Ellicott City, Md.
Wagner, John Harold,	C.E.,	Harrisburg.
Warner, Clarence William,	El.Met.,	East Orange, N. J.
Weishaupt, Robert Charles,	M.E.,	Lancaster.
Wensk, Joseph Anthony,	E.E.,	Baltimore, Md.
Wey, Howard Lee,	E.M.,	Bristol, Conn.
Wick, Albert James,	E.E.,	Washington, D. C.
Wiegner, William Kruse,	E.E.,	Bethlehem.
Wilbur, Robert Alexander, Jr.,	Ch.E.,	Elmira, N. Y.
Wolfe, Marmaduke Revenaugh,	El.Met.,	New York, N. Y.
Wysocki, de Victor, Jr.,	El.Met.,	Asbury Park, N. J.
Yard, Charles Frederick,	C.E.,	Trenton, N. J.
Yen, Chun Tai,	E.M.,	Kiangsi, China.
Youry, William Henry Simmons,	El.Met.,	Newark, N. J.

JUNIOR CLASS

Class of 1921

	Course	Residence
Albertson, Nicholas Arthur,	C.E.,	Atlantic City, N. J.
Alden, John Herbert,	El.Met.,	Washington, D. C.
Armstrong, Morris Simpson,	E.E.,	Red Bank, N. J.
Arner, William Joseph,	El.Met.,	Allentown.
Arnheimer, Leonard,	Ch.E.,	New York, N. Y.
Bailey, Harry Chantler,	C.E.,	Crafton.
Barthold, Allen Jennings,	B.A.,	Bethlehem.
Baver, David Ezra,	E.E.,	Shoemakersville.
Berger, Milton,	C.E.,	Atlantic City, N. J.
Berner, Carl Richard,	C.E.,	Pottsville.
Bertolet, John Lorah,	Ch.E.,	Reading.
Bevan, Lathrop,	C.E.,	East Orange, N. J.
Billinger, Robert Dominick,	Ch.E.,	Shenandoah.
Bingham, William Redmond,	Met.,	Harrisburg.
Blake, Robert Dayton,	B.A.,	Bethlehem.
Blom, Gustav Maurice,	C.E.,	Butztown.
Bottomley, Bertram Swaile,	C.E.,	Roanoke, Va.
Bowden, Edmund Warren,	C.E.,	Camden, N. J.
Bowman, Henry Tregellas,	M.E.,	Gilberton.
Bowman, Nelson Blair,	E.M.,	Brownsville.
Boynton, Henry Gaines,	Bus.,	New York, N. Y.
Brucher, Adam, Jr.,	B.A.,	Northampton.
Brugmann, William Hugh,	Met.,	Newark, N. J.
Burgess, Eugene Willard,	Bus.,	Joliet, Ill.
Butz, Louis Neuweiler,	El.Met.,	Allentown.
Carey, James Stark,	Ch.E.,	Harrisburg.
Childs, George Lawton,	Bus.,	New York, N. Y.
Childs, Raymond Austin,	Bus.,	New York, N. Y.
Chou, Smie Kwei,	M.E.,	Patung, Hupeh, China.
Christman, Frederick Mertz,	Ch.E.,	Reading.
Christman, LeRoy Fisher,	C.E.,	Womelsdorf.
Clark, Gerald Hunt,	B.A.,	Andover, N. J.
Clarke, David Messer,	C.E.,	Philadelphia.
Clarke, Sheldon Vanderbilt,	Bus.,	Williamsport.
Claxton, Edmund,	Ch.E.,	Narberth.
Comey, Paul Van Amringe,	Ch.E.,	Wenonah, N. J.
Coppersmith, Edward Adolph,	M.E.,	Egypt.

Davenport, Harold Robertson,	El.Met.,	West Pittston.
Dembo, Louis Julius,	C.E.,	Baltimore, Md.
Dixon, Lyman LeRoy,	El.Met.,	Flushing, N. Y.
Donovan, William Michael,	C.E.,	Philadelphia.
Dougherty, James Gwynne,	El.Met.,	Beaver.
Dvorschak, Ambrose Edward,	B.A.,	Drifton.
Dyer, Harry Buttorff,	C.E.,	Nashville, Tenn.
Eshbach, Irad Vernon,	Ch.E.,	Pennsburg.
Esterson, Milton Max,	M.E.,	Baltimore, Md.
Ettelman, Benjamin,	C.E.,	Philadelphia.
Farrington, James Royce,	C. E.,	Annandale, N. J.
Feringa, Peter Anthony,	C.E.,	Grand Haven, Mich.
Fisher, Lloyd Wellington,	B.A.,	Reading.
Flanagan, Frank Patrick,	E.M.,	Roanoke, Va.
Fleischer, Abraham,	C.E.,	Baltimore, Md.
Flom, Samuel Louis,	C.E.,	Northampton.
Forstall, Alfred Edmond, Jr.,	Bus.,	Montclair, N. J.
Frank, Paul Melville,	E.M.,	Allentown.
Frankenfield, Warren Ezra,	M.E.,	Ambler.
Gaiser, George Lincoln,	C.E.,	Newark, N. J.
Garrett, William Starling,	M.E..	Roanoke, Va.
Gildersleeve, Gordon Hamilton,	E.E.,	New York, N. Y.
Goldman, Hyman.	Ch.E.,	Easton.
Gonzalez, Eduardo,	M.E.,	Torreon, Mexico.
Goodell, Charles Graham,	C.E.,	Frederick, Md.
Good, Robert Charles,	Met.,	Camp Hill.
Goodwin, James Heathcott,	Bus.,	East Liverpool, O.
Gott, Eugene Cissell, Jr.,	El.Met.,	Washington, D. C.
Gulick, Henry Burr,	Ch.E.,	Brooklyn, N. Y.
Hall, Frank Allen,	B.A.,	Middletown, Conn.
Hall, William McLaurine, Jr.,	Ch.E.,	Parkersburg, W. Va.
Hartzell, Ralph,	Bus.,	Muncy.
Heiligman, Harold Abraham,	Ch.E.,	Lehighton.
Henneberger, Thomas Clinton,	E.E.,	Chambersburg.
Henrich, Vincent Christian,	Ch.E.,	Lebanon.
Hicks, Robert Clayton, Jr.,	E.E.,	Philadelphia.
Hinchman, Robert Mills,	Ch.E.,	Westfield, N. J.
Hollenback, Elliott Hudson,	El. Met.,	Reading.
Hood, John William,	El.Met.,	Knoxville, Tenn.
Howard, John Myers, Jr.,	Bus.,	Latrobe.
Huebner, James Kistler Mosser,	E.M.,	Allentown.

Ilyus, Edmund Burwell,	E.E.,	Lancaster.
Jacobs, Frank Aaron,	Ch.E.,	Bethlehem.
Johnson, Vernon Edward,	Bus.,	Southwick, Mass.
Jones, Howard Dewey,	C.E.,	Baltimore, Md.
King, Walter Cornelius,	Ch.E.,	Bethlehem.
Kistler, George Anson,	C.E.,	Allentown.
Kleckner, Ellis Henry,	M.E.,	Bethlehem.
Kline, John Milton,	Met.,	Allentown.
Kline, Luther Henry,	B.A.,	Northampton.
Knerr, George Russell,	Ch.E.,	Allentown.
Knerr, Russell Master,	B.A.,	Allentown.
Larson, Harry Gustave,	C.E.,	Limestone, N. Y.
Lawrie, William Newbold,	Bus.,	Oxford.
Lewers, William Wright,	Ch.E.,	Wilkes-Barre.
Locke, Harold Glenwood,	Ch.E.,	Camden, N. J.
Loeser, Edward Martin,	Ch.E.,	Elizabeth, N. J.
Long, Henry Laurence,	Ch.E.,	York.
McCarthy, John Donald,	E.M.,	Bethlehem.
McGovern, Edward William, Jr.,	Ch.E.,	Hammonton, N. J.
Maddox, Henry Randolph,	M.E.,	Princess Anne, Md.
Maginnes, Albert Bristol,	B.A.,	New York, N. Y.
March, Walter Stokley, Jr.,	E.M.,	Cynwyd.
Maurer, Charles Pehle,	E.M.,	Wilkes-Barre.
Merkel, Norman Schoenly,	Ch.E.,	East Greenville.
Miller, Albert Jacob,	M.E.,	Easton.
Miller, Frank William,	C.E.,	Reading.
Morgan, James Willard,	E.M.,	Altoona.
Morgan, Warren Thomas,	M.E.,	Freeland.
Mullady, Thomas Francis,	E.M.,	Brooklyn, N. Y.
Myers, Walter Frey, Jr.,	E.M.,	York.
Nass, George, III.,	M.E.,	Philadelphia.
Nesterowicz, John James,	Ch.E.,	Buffalo, N. Y.
Norkiewicz, John Anthony,	C.E.,	Shenandoah.
Oehm, Frederick Arthur,	M.E.,	Baltimore, Md.
Parker, Willis Jones,	B.A.,	West Pittston.
Perry, Robert Swain, Jr.,	Ch.E.,	Philadelphia.
Pfeiffer, David Clifford,	M.E.,	Washington, D. C.
Power, Paul Carroll,	Met.,	Crafton.
Powles, John Grant,	Met.,	Los Angeles, Cal.
Pumphrey, John Walter,	C.E.,	Brooklyn, Md.
Pursel, Harold Reinhardt,	M.E.,	Danville.

Raff, Richard Davis,	Ch.E.,	Canton, O.
Raiguel, Jackson Bornman,	Ch.E.,	Jenkintown.
Rathbone, Monroe Jackson, Jr.,	Ch.E.,	Parkersburg, W. Va.
Rheinfrank, Frederick Wagner,	Bus.,	Port Chester, N. Y.
Rice, Robert MacLean,	E.E.,	Reading.
Richards, Samuel Simes, Jr.,	Ch.E.,	Rosemont.
Riebe, Herman William,	C.E.,	Lansford.
Rights, Theodore Balfour,	C.E.,	Roselle, N. J.
Ritchie, Paul,	M.E.,	Millville, N. J.
Robinson, Robert Parks,	C.E.,	Chester.
Rogers, Bryant King,	E.M.,	Montclair, N. J.
Roy, Ernest Hood,	M.E.,	Newton, N. J.
Rudy, Walter Dana,	Ch.E.,	Mt. Airy, Md.
Sakievich, Anthony Joseph,	C.E.,	Baltimore, Md.
Savaria, Gaspard Maurice,	E.E.,	Woonsocket, R. I.
Saxman, Marcus Suydam,	E.M.,	Latrobe.
Sayre, William Heysham, Jr.,	M.E.,	Glen Ridge, N. J.
Schneider, Carl Louis,	M.E.,	Elizabeth, N. J.
Schofer, Carl Henry,	E.M.,	Reading.
Schrader, Michael Cornelius,	B.A.,	Bethlehem.
Schuessler, William John,	C.E.,	Philadelphia.
Schulz, Donald deVantier,	Met.,	Bethlehem.
Shaner, George Faust,	C.E.,	Pottstown.
Sherry, Marlow Wilke,	E.M.,	Allentown.
Shipherd, John Jay,	Ch.E.,	Evansville, Ind.
Skillman, John Malcolm,	E.E.,	Oldwick, N. J.
Slabasesky, Henry Theodore,	E.E.,	Ashley.
Steacy, Henry Hershey,	M.E.,	York.
Steiner, Carl Herman,	E.E.,	Reading.
Stelle, Harold Alexander,	Ch.E.,	Scranton.
Streeter, Dwight Newton,	M.E.,	Belleville, N. J.
Summers, Miles Whitney,	C.E.,	Washington, D. C.
Sunderland, William Alexander,	E.M.,	Danbury, Conn.
Tachovsky, John Philip,	M.E.,	Bethlehem.
Thomas, Ross Raymond,	M.E.,	Hammonton, N. J.
Thompson, George Stephen,	E.M.,	Shaft.
Vogeley, Thomas Kenneth,	E.M.,	Butler.
Walker, Percy Franklin,	C.E.,	Harrisburg.
Ward, Clemson Hays,	Chem.	Oil City.
Wasser, Norman Henry,	Ch.E.,	Bethlehem.
Wear, Paul Guy,	Ch.E.,	Bethlehem.

Weiss, Peter Francis,	B.A.,	Bethlehem.
Wentz, Ralph Roth,	El.Met.,	Allentown.
Whitmore, William Kendal,	E.M.,	Shamokin.
Widmyer, John Henry,	Chem.	Lancaster.
Wildman, George Andrew,	E.E.,	Bridgeport, Conn.
Willard, Bradford,	B.A.,	Plainfield, N. J.
Wilson, Alvin Turner,	Ch.E.,	Bethlehem.
Winterhalter, William Charles, Jr.,	Met.,	Pittsburgh.
Woodring, Ralph Walton,	Ch.E.,	Bethlehem.
Wright, Charles Henry,	C.E.,	St. Clair.
Wright, Henry Ovington,	M.E.,	Westfield, N. J.
Yeide, Harry Elwood,	E.E.,	Weatherly.
Yu, Ching-Sung,	C.E.,	Kulangsu, Amoy, China.

SOPHOMORE CLASS

Class of 1922

	Course	Residence
Allen, Roy Dawson,	M.E.,	Belvidere, N. J.
Alrich, John Duffield,	E.E.,	Lake Carey.
Altmiller, Charles Henry,	E.M.,	Hazleton.
Amig, William Van Wert,	M.E.,	Baltimore, Md.
Ancona, Frederick Bechtel,	E.E.,	Reading.
Aspen, Paul Herbert,	C.E.,	Philadelphia.
Bachman, Wilbur George Tripple,	Bus.,	Allentown.
Badham, John Terry,	E.M.,	Birmingham, Ala.
Bailey, Fred Elliott,	N.E.,	Cazenovia, N. Y.
Barthold, Lee Girard,	Bus.,	Bethlehem.
Beeckel, Hermann Charles,	E.M.,	Philadelphia.
Bergdoll, Fred Ferdinand,	B.A.,	York.
Berger, Edgar Milton,	M.E.,	Allentown.
Best, Ralph Walter,	E.E.,	Allentown.
Bobbin, Raymond Joseph,	Ch.E.,	Shenandoah.
Bockel, George Robert,	C.E.,	Altoona.
Boltz, Joseph Light,	C.E.,	Lebanon.
Bowler, William Lloyd,	M.E.,	Glenside.
Bowman, Paul Emil,	Ch.E.,	Gilberton.
Boyle, Norman Thomas,	E.E.,	Bethlehem.
Brady, Harry Kidwell, Jr.,	Met.,	Pittsburgh.

Brewer, Warren,	Bus.,	Newton Center, Mass.
Brodnax, William Frederick, Jr.,	M.E.,	Bethlehem.
Brumbaugh, Granville Martin,	E.E.,	Washington, D. C.
Brunstein, Maurice,	Ch.E.,	Atlantic City, N. J.
Bush, Donald Moyer,	Ch.E.,	Glenside.
Carey, James White, Jr.,	M.E.,	Wenonah, N. J.
Carpenter, Clinton Grier,	Ch.E.,	Brooklyn, N. Y.
Carroll, Henry,	M.E.,	Bethlehem.
Chen, Chung-Fa,	E.M.,	Changsha, China.
Chisholm, Henry Lewis, Jr.,	M.E.,	Buffalo, N. Y.
Clark, Richard James,	Ch.E.,	Bethlehem.
Cohen, Aaron Jacob,	C.E.,	Trenton, N. J.
Cohen, Samuel Meyer,	C.E.,	Bridgeport, Conn.
Coleman, Lee Heicher,	M.E.,	Steelton.
Connell, Charles Augustus,	M.E.,	Plattsburg, N. Y.
Corcoran, Lewis La Mont,	C.E.,	Bethlehem.
Cottrell, Samuel, Jr.,	Ch.E.,	Takoma Park, D. C.
Coxe, Edward Haviland, Jr.,	E.E.,	Pittsburgh.
Craig, Colgate,	Ch.E.,	Montclair, N. J.
Crawford, James Coalter, Jr.,	E.M.,	Mount Vernon, N. Y.
Damiani, Pasquale George,	B.A.,	Bethlehem.
Daniels, Elliott Foster,	E.E.,	Jersey City, N. J.
Davis, Guild Darwin,	M.E.,	East Orange, N. J.
Day, Harrie Lyon,	Met.,	Ogdensburg, N. Y.
Deats, Charles Taylor,	E.E.,	Flemington, N. J.
De Dan, Jules Felix,	C.E.,	Atlantic City, N. J.
De Turk, Elmer Francis,	E.E.,	Reading.
Dimmig, Daniel Benjamin,	E. M.,	East Greenville.
Doan, William Douglas,	E.M.,	Lansdale.
Downes, Kenneth McIntire,	Ch.E.,	Harrisburg.
Downing, Edmond Joseph,	C.E.,	Wilkes-Barre.
Drew, Leslie Lungren,	Bus.,	Asbury Park, N. J.
Dunkle, Charles Josiah,	Bus.,	Harrisburg.
Dunkle, Josiah Andrew,	Ch.E.,	Steelton.
Eastman, Robert William,	Met.,	Mount Vernon, O.
Enslin, Everett Morgan,	N.E.,	Bethlehem.
Ewing, George Newlin,	Met.,	Philadelphia.
Faxon, Clifford Henry,	C.E.,	Huntington, N. Y.
Fisher, Jacob Runkle,	M.E.,	Oldwick, N. J.
Fleming, Richard, Jr.,	Ch.E.,	Westfield, N. J.
Foote, Marshall Hanford,	Bus.,	South Norwalk, Conn.

Forney, Herman Charles,	C.E.,	Philadelphia.
Frain, Jacob Frank,	C.E.,	Williamsport.
Frankel, Harry,	B.A.,	Wilmington, Del.
Freeman, Carlos Alphonso,	E.M.,	Caracas, Venezuela.
Fresoli, Michael,	B.A.,	Bethlehem.
Fretz, John Clement,	E.E.,	Trenton, N. J.
Gandal, Isadore,	C.E.,	Bethlehem.
Gangewere, Ernest Paul,	M.E.,	Chattanooga, Tenn.
Gerber, William Eugene,	Ch.E.,	York.
Gerlach, Jacob Aaron,	M.E.,	Easton.
Gillespie, Elwood David,	Ch.E.,	Catasauqua.
Gingrich, Winfield Adam,	C.E.,	Williamsport.
Glasmire, Frederick Wanner,	Ch.E.,	Womelsdorf.
Glen, Maxwell,	Bus.,	Newbury, Mass.
Goldcamp, Cyril Finton,	Ch.E.,	Ironton, O.
Gooding, Charles Pennypacker,	B.A.,	Wilmington, Del.
Grace, George Joseph,	Bus.,	Brooklyn, N. Y.
Green, David,	N.E.,	Atlantic City, N. J.
Greenall, Charles Huntington,	M.E.,	Allentown.
Greene, Omar Vivien,	Met.,	Yonkers, N. Y.
Greenleaf, Eric Rodney,	Ch.E.,	Bethlehem.
Griswold, Edgar Merrill,	Met.,	Syracuse, N. Y.
Gross, Abraham Albert,	Ch.E.,	Harrisburg.
Gulick, Wilson McKee,	E.M.,	Orange, N. J.
Handwerk, Erwin Casper,	B.A.,	Slatedale.
Harris, Nathaniel Kirby,	C.E.,	Athens.
Hartman, Edward Paul,	M.E.,	Bethlehem.
Hartshorne, Alfred Cope,	N.E.,	Phoenixville.
Hartsock, Edward Chambers,	B.A.,	Scranton.
Hastings, Robert William,	Bus.,	Joliet, Ill.
Hatch, Allen,	E.M.,	Philadelphia.
Herman, Arthur Louis,	Met.,	Bethlehem.
Herrington, Arthur Smith,	Bus.,	Latrobe.
Hess, Jacob Frederick,	Met.,	Massillon, O.
Hewitt, Alfred George,	Ch.E.,	Washington, D. C.
Hindry, Walter Fitz James,	Ch.E.,	St. Augustine, Fla.
Hitchner, Adam Hannan,	E.M.,	Woodbury, N. J.
Hoch, Albert Jackson,	Met.,	Reading.
Hocker, John Stanley,	Met.,	Middletown.
Hofford, Herbert Malcolm,	Chem.,	Allentown.
Hopkins, George Whitefield,	M.E.,	Cleveland, O.

Horine, John Winebrenner, Jr.,	E.E.,	Columbia, S. C.
Howerth, Dwight Goldwin,	E.E.,	Shamokin.
Huang, Shou-Chuan,	E.M.,	Kaiping, China.
Huber, Francis, Christian,	Ch.E.,	New York, N. Y.
Huffman, Francis Miller,	Met.,	Bethlehem.
Hughart, William Oden,	Met.,	Grand Rapids, Mich.
Hughes, Rupert De Armond,	Ch.E.,	Montclair, N. J.
Hull, John Sommers,	M.E.,	Cleveland, O.
Hurtado, Juan,	C.E.,	Mexico City, Mexico.
Ide, Clinton,	E.E.,	Harvey's Lake.
Irvin, Robert Lintner,	Met.,	Meadville.
Israel, Fielder,	Ch.E.,	Laurel, Md.
Jacobs, Mahlon Kemmerer,	E.M.,	Philadelphia.
Jagels, Charles John Henry,	B.A.,	New York, N. Y.
Jefferson, Moncrief Ostrander,	N.E.,	Riverhead, N. Y.
Job, James Robert,	C.E.,	Nanticoke.
Kahn, Noah Abraham,	Ch.E.,	Montrose.
Katzenstein, Leo,	B.A.,	Johnstown.
Kay, Sidney Garner,	Met.,	Harrisburg.
Keeley, Martin Jerome,	Bus.,	Hoboken, N. J.
Keenan, Raymond Anthony,	Met.,	New Kensington.
Kehler, Lloyd Benjamin,	M.E.,	Shamokin.
Kennedy, Dewey Lester,	Bus.,	Duncannon.
Kennedy, James Neilson,	Bus.,	Youngstown, O.
Kilbourn, William Robert,	M.E.,	Williamsport.
Killmer, Jack Kaufman,	Met.,	Reading.
Kivert, Joseph Albert,	Ch.E.,	Northampton.
Kleine, Herbert Julius,	M.E.,	Altoona.
Knies, Earl Vernon,	M.E.,	Bethlehem.
Knoderer, Claude Luther,	E.E.,	Steelton.
Kopf, Otto Willard,	E.E.,	New Britain, Conn.
Korbel, Alexander,	M.E.,	Bethlehem.
Kozlakiewicz, Walter,	C.E.,	Wilkes-Barre.
Laffey, Alfred Walsh Barnes,	Bus.,	Paterson, N. J.
Lamb, Earl Washington,	E.M.,	Natalie.
Landenberger, John Louis,	N.E.,	Germantown.
Larkin, Paul Revere,	C.E.,	Wollaston, Mass.
Larkin, Sylvester Makens,	C.E.,	Norristown.
Lawton, Joseph Lewis,	E.M.,	Claremont, W. Va.
Lee, Ralph William, Jr.,	C.E.,	Washington, D. C.
Lerch, Robert Lee,	Ch.E.,	Takoma Park, D. C.

Lewando, Royal Dewey,	C.E.,	Bethlehem.
Linderman, Robert Packer,	Bus.,	Bethlehem.
Little, Arthur Rhea,	Met.,	Petersburg.
Liveright, Henry,	Ch.E.,	Clearfield.
Lorch, George Herman,	E.E.,	Washington, D. C.
Lutz, Warren Hornberger,	E.E.,	Denver.
McCrindle, Nelson Johnson,	C.E.,	Olivers Mills.
McFadden, John Joseph,	E.E.,	Allentown.
Macdonald, George Ranold,	Bus.,	Dorchester.
Major, Harold Wagner,	Ch.E.,	Lehman.
Maraspin, Davis Goodwin,	Bus.,	Malden, Mass.
Marshall, James Floyd,	M.E.,	Wilkes-Barre.
Marshall, John Noble,	C.E.,	Pittsburgh.
Mason, Charles Thomas, Jr.,	M.E.,	Germantown.
Mattson, William Raymond,	C.E.,	Rockledge.
Meissner, James Walter,	E.E.,	Butztown.
Mellinger, Henry Ross,	Bus.,	Leetonia, O.
Mello, Eustaquio Gomes de,	E.E.,	Capella, Alagoas, Brazil.
Mercur, Robert Sayre,	E.M.,	Harrisburg.
Michell, Albert McIlvaine,	E.M.,	Marion, Ky.
Miller, Paul Edward,	N.E.,	Bellwood.
Miller, Roy Francis,	E.M.,	Altoona.
Miszkiel, Victor Stanly,	E.E.,	Ashley.
Monroe, Stewart,	Bus.,	Cleveland, O.
Moorehouse, John Walter,	E.E.,	Monaca.
Morgan, Harold William,	C.E.,	Altoona.
Mulford, Hilliard Nelson,	Ch.E.,	Brooklyn, N. Y.
Mumford, Warren Huidekoper,	Bus.,	Plainfield, N. J.
Mumma, Paul Fisher,	Met.,	Waynesboro.
Nadig, Stanton Elwell,	N.E.,	Allentown.
Newlin, James Mennert,	E.M.,	Sparrows Point, Md.
Nichols, Robert Warren,	E.E.,	Asbury Park, N. J.
Niekamp, William Stacy,	Met.,	St. Louis, Mo.
O'Keefe, Gerald Carroll,	Bus.,	New Haven, Conn.
Ott, Harold Joseph,	Ch.E.,	Allentown.
Pancoast, Leon Gifford,	M.E.,	Delanco, N. J.
Pasolli, Emil Gabriel,	E.M.,	Paterson, N. J.
Pent, Robert Edward,	Bus.,	Jenkintown.
Pfeiffer, John,	Ch.E.,	Washington, D. C.

Platt, Harold Wentzell,	C.E.,	Bridgeton, N. J.
Potts, Ralph Harrison,	Ch.E.,	Reading.
Prigohzy, Adolph,	E.M.,	Brooklyn, N. Y.
Rauch, Earnest Adam,	M.E.,	Emerald.
Redline, Paul Wilson,	M.E.,	Bethlehem.
Reichard, Paul Clader,	M.E.,	Allentown.
Rex, Harold Berlin,	E.E.,	Lehighton.
Reynolds, Edwin Louis,	C.E.,	Bethesda, Md.
Rhoad, Robert Rodney,	N.E.,	Bethlehem.
Ricketts, Leslie Cutler,	M.E.,	Barre, Mass.
Roche, George Joseph,	E.E.,	Baltimore, Md.
Ryerson, William Nicholas,	C.E.,	Sussex, N. J.
Salmon, Clarence Prior,	Ch.E.,	La Salle, N. Y.
Saltzman, Auguste Louis,	M.E.,	East Orange, N. J.
Sanborn, Norman Prime,	C.E.,	East Cleveland, O.
Satterthwait, Charles Shoemaker,	C.E.,	Burmont.
Schaefer, Bernard Edward,	E.M.,	Allentown.
Schaub, William Otto,	E.M.,	Baltimore, Md.
Schier, Wallace,	Bus.,	Richmond Hill, N. Y.
Schlesman, Carlton Hecker,	Ch.E.,	Allentown.
Schonhardt, John Clarence,	Met.,	Johnstown.
Schwartz, Earl Dum,	C.E.,	Harrisburg.
Scofield, Edmond Preston,	Ch.E.,	Bayonne, N. J.
Sharp, Charles Compton,	C.E.,	Bridgeton, N. J.
Shearer, Walter Louis,	Ch.E.,	Washington, D. C.
Shipley, Samuel Hunt,	Ch.E.,	York.
Silsby, Charles Forbes,	Ch.E.,	Washington, D. C.
Smith, Hubert Bell,	C.E.,	Philadelphia.
Snyder, Amandus Deischer, Jr.,	Ch.E.,	Pennsburg.
Spatz, Warren Cyrus,	E.E.,	Reading.
Sprecher, Samuel Roy,	E.E.,	East Petersburg.
Stimson, Earl, Jr.,	M.E.,	Roland Park, Md.
Strauch, Charles Carter,	M.E.,	Pottsville.
Stutz, George Frederick Adelbert,	Ch.E.,	Washington, D. C.
Swinton, George Robert,	C.E.,	Atlantic City, N. J.
Switz, Theodore MacLean,	Ch.E.,	East Orange, N. J.
Tavenner, William Henry,	E.M.,	Washington, D. C.
Terry, Peyton Lefturich,	M.E.,	Roanoke, Va.

Thaeler, Abraham Schropp,	N.E.,	Nazareth.
Tomlinson, Robert Scott,	E.E.,	Elizabeth, N. J.
Van Nort, Lawrence Northrup,	M.E.,	Scranton.
Vilotti, James Victor,	Bus.,	Philadelphia.
Vogt, Harold James,	Ch.E.,	Brooklyn, N. Y.
Wallace, Harold Dolson,	C.E.,	East Orange, N. J.
Walmsley, Haines Preston,	Met.,	Birmingham, Ala.
Walters, George Wilmer,	Met.,	Cazenovia, N. Y.
Waltz, William Hurr,	C.E.,	Williamsport.
Warren, Austin Bartlett,	N.E.,	Westfield, Mass.
Weaver, William Abbott,	Ch.E.,	Wilkes-Barre.
Weber, Herman Ludwig,	B.A.,	Allentown.
Weiss, Theodore Solomon,	Chem.,	Quakertown.
Whims, Edmund Joseph,	C.E.,	St. Clair.
Whitney, Leslie Clifton,	Met.,	Marlboro, Mass.
Whytock, Paul Knauss,	Bus.,	Bethlehem.
Williams, Wentworth,	M.E.,	Woodstock, Vt.
Williamson, Stuart Worley,	E.M.,	Womelsdorf.
Wilson, Francis Vaux, Jr.,	Bus.,	Philadelphia.
Wilson, John Edgar Miller,	E.M.,	Bethlehem.
Wilson, Ralph Lawrence,	Met.,	Canton, O.
Wingate, Abram Reber, Jr.,	C.E.,	Washington, D. C.
Woelfel, Harold Martin,	N.E.,	Freeland.
Wolfe, Charles Russell,	Ch.E.,	Cranbury, N. J.
Wood, Robert Thomas,	Met.,	Palmerton.
Yap, Alfred Tsien Leong,	Bus.,	Honolulu, Hawaii.

FRESHMAN CLASS

Class of 1923

	COURSE	RESIDENCE
Abel, Stanford Edward,	C.E.,	Washington, D. C.
Achern, Howard Francis,	B.A.,	Wakefield, Mass.
Adams, Robert Wilson,	E.M.,	Crafton.
Allen, George Kestwer,	Ch.E.,	Reading.
Andrews, Burton Frederick,	B.A.,	Nazareth.
Appel, Carl Wilson,	E.E.,	Allentown.
Asbury, Thomas Henry,	Bus.,	Philadelphia.
Bachman, Charles,	M.E.,	Lancaster.
Bahnsen, Conrad Mortimer,	B.A.,	Coopersburg.
Balderson, Robert Power,	Bus.,	Wilkinsburg.

Balliet, Madison Calvin,	E.E.,	Slatington.
Barber, Frederick Edwin,	E.E.,	Allentown.
Barrall, John Kenneth,	B.A.,	Allentown.
Barrell, Robert Webb, Jr.,	E.E.,	St. Louis, Mo.
Bates, Frederick Woolworth,	E.M.,	Canton, Ohio.
Beale, Edward Belknap,	Ch.E.,	Washington, D. C.
Beardmore, William Rudolph,	C.E.,	Jersey City, N. J.
Beck, Rodney Maurer,	Ch.E.,	Germantown.
Beitzel, Horace Clifton, Jr.,	M.E.,	Philadelphia.
Bell, George Howard,	E.M.,	Canton, Ohio.
Bercovit, Benjamin,	B.A.,	Bethlehem.
Bereznay, John Thomas,	M.E.,	Clairton.
Bergquist, Herbert Carl,	Bus.,	Brockton, Mass.
Berry, Henry Parmentier,	E.E.,	Washington, D. C.
Bieg, Henry Conrad,	E.M.,	Philadelphia.
Birk, Arnold Robert,	E.M.,	Bethlehem.
Bishop, Charles Fletcher,	E.E.,	Williamsport.
Blakeley, George Bogart,	Bus.,	Bethlehem.
Blankenbuehler, John Henry,	E.E.,	Elizabeth.
Bloch, Elmer Morton,	B.A.,	Easton.
Boardman, John,	C.E.,	Philadelphia.
Bodey, Carl Franklin,	E.E.,	Reading.
Borden, George Centennial, Jr.,	Ch.E.,	Asbury Park, N. J.
Boyd, James Andrew,	Bus.,	Montvale, N. J.
Boyden, Wilson Gordon,	E.E.,	Greenwich, Conn.
Boyer, Wilbur Albert Solomon,	B.A.,	Lehighton.
Bradley, Isaac Vincent, Jr.,	E.M.,	Woodlynne, N. J.
Bray, Lennox Jerome,	M.E.,	Westerly, R. I.
Brightbill, David Frantz,	E.E.,	Lebanon.
Brotzman, Reginald Philip,	E.E.,	Bethlehem.
Bruner, Francis Daniel Pastorius,	E.M.,	Roanoke, Va.
Buckley, John Brooke,	N.E.,	Philadelphia.
Buller, William Earl,	Bus.,	Harrisburg.
Burgess, Charles Owen,	Met.,	Niagara Falls, N. Y.
Burkholder, Harry James,	M.E.,	McKeesport.
Burleigh, Franklin Stewart,	B.A.,	Boonville, N. Y.
Bush, Charles Roland,	C.E.,	Washington, D. C.
Butler, Wiley Harper,	C.E.,	Elliott, N. C.

Callahan, George White Gregory, Jr.,	C.E.,	Newport, R. I.
Camm, John Palmer,	E.M.,	Atlantic City, N. J.
Campbell, Paul,	M.E.,	Mechanicsburg.
Caprario, Louis,	E.E.,	Elizabeth, N. J.
Carlisle, William Albert,	E.E.,	DuBois.
Carlson, Joseph Martin Napoleon,	B.A.,	South Renovo.
Cassady, Franklin Frederick,	C.E.,	Philadelphia.
Christman, Calvin Claude,	B.A.,	Lehighton.
Christman, John Daniel,	C.E.,	Womelsdorf.
Church, Allan Hudson,	Ch.E.,	Elizabeth, N. J.
Claxton, Robert Bethell, Jr.,	Bus.,	Narberth.
Cleeland, John Henry,	Bus.,	Elkins Park.
Colburn, William Edward, Jr.,	M.E.,	Washington, D. C.
Colby, Franklin Hornor,	E.M.,	Andover, N. J.
Coleman, Douglas Fleming,	B.A.,	Jersey City, N. J.
Compher, Wilfred Clinton,	Bus.,	Poolesville, Md.
Comrie, Arthur Joseph,	Ch.E.,	Cranford, N. J.
Conklin, William Swiler,	Bus.,	Middletown.
Conlin, John Francis,	Bus.,	Germantown.
Conroy, James Maurice,	B.A.,	Burlington, N. J.
Cornelius, George Emil Wagner,	Bus.,	McKeesport.
Cornell, Francis Shepard,	Met.,	Yonkers, N. Y.
Cosh, William Harold,	C.E.,	Vineland, N. J.
Costenbader, Elvin Benjamin,	E.E.,	Slatington.
Cousens, Harold Franklin,	Bus.,	Arlington, Mass.
Cox, Newton Perkins,	E.E.,	Philadelphia.
Craig, Thomas,	M.E.,	Slatington.
Crawford, David William,	E.E.,	Scranton.
Creighton, Arthur Morgan,	Met.,	Bayonne, N. J.
Cusick, Arthur Cabot,	M.E.,	Roxbury, Mass.
Darsie, James Hazen,	E.M.,	West Homestead.
Davenport, John Bloss,	M.E.,	Elizabeth, N. J.
Davis, Edward Chester,	M.E.,	Taylor.
Davis, Norris Dunglison,	Bus.,	Conshohocken.
Davis, William Shaff, Jr.,	C.E.,	Lebanon.
Dawson, Henry Americus, Jr.,	Bus.,	Rockville, Md.
Decker, Everett Judd,	E.M.,	Mountain Lakes, N. J.
Dehnick, Joseph Albert,	C.E.,	Atlantic City, N. J.
DeMoyer, Frank Hart,	C.E.,	Camden, N. J.

Denburger, Fred Herman,	C.E.,	Bethlehem.
DePuy, Stuart Walton,	Ch.E.,	Hammonton, N. J.
Derrick, Charles Luther,	E.E.,	Washington, D. C.
Desh, George Jacob,	B.A.,	Bethlehem.
Dieffenbach, Ernest Guy,	Met.,	Harrisburg.
Dierkoph, Henry Knefley,	M.E.,	Washington, D. C.
Di Giulian, Attilio Peter,	C.E.,	Washington, D. C.
Dillon, James LeRoy,	M.E.,	Wilmington, Del.
Dithridge, Edward Hay,	Ch.E.,	Morrisville.
Dodge, Wilson Henry,	Bus.,	Port Washington, N. Y.
Douglass, Leo Frederick,	Bus.,	Wakefield, Mass.
Dolan, Hugh Francis,	E.M.,	Pottsville.
Douglas, Randolph Angus,	M.E.,	Plainfield, N. J.
DuBois, Howard Higbee,	C.E.,	Philadelphia.
Dynan, Harold Baker,	Met.,	Bethlehem.
Eckfeldt, Jacob Trousselle,	Bus.,	Bethlehem.
Eichelberger, William Sweet,	Bus.,	Saxton.
Ekstedt, Oscar Carl,	B.A.,	Rochester.
Ellis, George Conkling,	Bus.,	Basking Ridge, N. J.
Erb, John Edgar,	Met.,	Middletown.
Ertner, Harold Sigmond,	C.E.,	Camden, N. J.
Eshbach, Truman Walter,	B.A.,	Bethlehem.
Evans, Wendell Everett,	E.M.,	Moosic.
Fagan, Marvin Troy,	E.E.,	Weatherly.
Fancher, Charles Melvin,	N.E.,	Elizabeth, N. J.
Farkas, Harold,	Ch.E.,	Newark, N. J.
Farley, Walter Reynolds,	B.A.,	Erie.
Fay, Frederick Hamilton,	Ch.E.,	Cranford, N. J.
Fehr, Howard Franklin,	B.A.,	Bethlehem.
Felmley, Charles Lauren,	E.E.,	Oldwick, N. J.
Felty, Warren David,	B.A.,	Lebanon.
Ferguson, Frank Elliott, Jr.,	E.E.,	Plainfield, N. J.
Ferrer, Edward Thomas,	C.E.,	Havana, Cuba.
Ferris, Edwin Alden,	M.E.,	Ridgefield Park, N. J.
Ferry, John Francis,	E.E.,	Allentown.
Fielding Charles Trumbower,	M.E.,	Scranton.
Fincke, Edward Jerome,	E.M.,	Glenside.
Fisher, Craig Royston,	Bus.,	Newburyport, Mass.
Fitch, Grant,	Ch.E.,	Washington, D. C.
Focht, Louis Doster,	E.M.,	Trenton, N. J.
Foot, Cyril Hughes,	M.E.,	Westfield, N. J.

Forney, Charles David,	E.M.,	Hanover.
Forstall, Charles Fletcher,	C.E.,	Rosemont.
Fortuin, David,	M.E.,	Nazareth.
Fortune, Edward Stewart,	E.E.,	Mt. Vernon, N. Y.
Frazier, Donald Plumb,	Bus.,	Aurora, Ill.
Fry, Wallace Cordner,	Bus.,	Asbury Park, N. J.
Fryer, Leslie Clarke,	C.E.,	Camden, N. J.
Fulmer, Donald Book,	Met.,	Coatesville.
Ganey, Thomas Vincent,	Bus.,	Bethlehem.
Garber, Meyer Isadore,	Ch.E.,	Bridgeport.
Gardy, Julian Washington,	C.E.,	Doylestown.
Garman, Edwin Lester Meckley,	Met.,	Penbrook.
Gaver, John Milton,	Bus.,	Frederick, Md.
Gentzlinger, Henry Werner,	C.E.,	New York, N. Y.
Getz, David,	B.A.,	Northampton.
Gihon, Harry David,	M.E.,	Trenton, N. J.
Gillett, Harry, Jr.,	M.E.,	Cleveland, O.
Glasmire, Samuel Wanner,	B.A.,	Bethlehem.
Goddard, Howard Crosby,	B.A.,	Philadelphia.
Goldberg, Horace Harrison,	B.A.,	Jenkintown.
Gould, James Wilmot,	M.E.,	Johnstown.
Graff, Richard Morris,	E.M.,	Worthington.
Graham, George Tinsley,	Bus.,	Bethlehem.
Green, Kenneth William,	E.E.,	Weissport.
Greene, Nelson George,	M.E.,	Lebanon.
Groff, Joseph Coblentz,	M.E.,	New York, N. Y.
Grundy, Park Alan,	B.A.,	New York, N. Y.
Hacker, Robert Trost,	E.M.,	Toledo, O.
Hafler, LeRoy Amandus,	C.E.,	Bingen.
Hagenbuch, Edward Allen, Jr.,	E.E.,	Allentown.
Hager, William Franklin,	Bus.,	Bethlehem.
Hale, Oscar Hamilton,	B.A.,	Glenside.
Hales, Ralph Alonzo,	Ch.E.,	Washington, D. C.
Hall, George Arthur,	Bus.,	East Orange, N. J.
Hallihan, Edward Britt,	Bus.,	New York, N. Y.
Hardcastle, Edward,	E.E.,	Easton, Md.
Harkins, Linus Kenneth,	B.A.,	Homestead.
Harris, Thomas Wilson,	C.E.,	Athens.
Hart, John Richard,	M.E.,	Duncannon.
Hartung, Philip Halstead,	M.E.,	Newport, R. I.
Hauck, Adam Edward,	E.M.,	Buffalo, N. Y.

Heagney, William Thomas,	B.A.,	Worcester, Mass.
Heffernan, Thomas Easen,	E.M.,	Wilkes-Barre.
Heikes, George Conrad,	Bus.,	Salt Lake City, Utah.
Helfrich, Cyril Cecil,	M.E.,	Bath.
Helffrich, Lawrence Stockton,	Bus.,	Yonkers, N. Y.
Hendrickson, Lynn Francis,	Ch.E.,	Woodbury, N. J.
Henry, William Keeler,	C.E.,	York.
Henzelman, Carl Franklin,	Bus.,	Easton.
Hering, Henry Richardson,	M.E.,	New York, N. Y
Herr, Richard,	C.E.,	Strasburg.
Hewson, Edward Haskell,	N.E.,	Madison, N. J.
Hibler, Christopher Arthur,	Ch.E.,	Harrisburg.
Hicks, Albert Willet, Jr.,	E.M.,	Allentown.
Hiestand, John Engle,	Met.,	Bainbridge.
Hill, Lynn Douglas,	B.A.,	Syracuse, N. Y.
Hogg, Wallace Bruce,	Bus.,	Pittsburgh.
Hoke, William Mason,	E.E.,	Lebanon.
Hornbostel, Lloyd,	B.A.,	New York, N. Y.
Horowitz, Abraham Charles,	Ch.E.,	Jersey City, N. J.
Huber, Raymond Fahnestock,	N.E.,	Chambersburg.
Huffman, Raymond Lloyd,	E.M.,	Bethlehem.
Huggins, Georg Allen, 3d,	M.E.,	Brooklyn, N. Y.
Huggins, William Grenell,	Bus.,	Adams, N. Y.
Humphrey, John Milton, Jr.,	Bus.,	Wilkes-Barre.
Huston, James Stewart,	Met.,	Coatesville.
Israel, Charles Henry, Jr.,	Ch.E.,	Scranton.
Jacobson, Louis John,	C.E.,	Washington, D. C.
Johnson, Alfred William,	E.E.,	West Hartford, Conn.
Johnson, Isaac Stewart,	Met.,	New York, N. Y.
Johnston, Byron Albert Chapman,	E.M.,	Tompkinsville, N. Y.
Kelley, Charles Joseph,	Bus.,	Luzerne.
Kennedy, Jamieson Douglas,	B.A.,	Chicopee Falls, Mass.
Kiechel, Leonard David,	B.A.,	Northampton.
Kistler, Hiram P.,	Ch.E.,	Stony Run.
Klaas, Walter Ernest,	Bus.,	New York, N. Y.
Kling, Herbert,	B.A.,	Providence, R. I.
Klingman, Lars Edward,	B.A.,	Millersburg.
Knepper, Henry, Jr.,	E.E.,	Somerset.
Knodel, Charles Gutthilf,	M.E.,	Allentown.
Knouse, Walter Earl,	E.E.,	Washington, D. C.

Koch, George Schneider,	E.E.,	Washington, D. C.
Kocher, Walter Merritt,	C.E.,	Allentown.
Kramer, Allan Reuel,	E.E.,	Coplay.
Kramer, Harold Kusel,	M.E.,	Brooklyn, N. Y.
Kravitz, Raphael,	C.E.,	Atlantic City, N. J.
Kreisel, John Werner,	B.A.,	Pen Argyl.
Kressler, Charles Horner,	E.E.,	Finesville, N. J.
Kurtz, Irwin Faust,	C.E.,	Pottstown.
Lamb, Russell Maynard,	Bus.,	Rockford, Ill.
Lambert, Tilghman Albert,	B.A.,	Bethlehem.
Lapp, Edward John,	Bus.,	Montclair, N. J.
Lare, Loyd Anthony,	Bus.,	Conshohocken.
Latshaw, Ray Eisenberg,	M.E.,	Royersford.
Laufer, Harry Edgar,	Bus.,	Bethlehem.
Laughton, William Miller,	Met.,	Washington, D. C.
Lawrence, Ernest,	B.A.,	Bristol.
Lazarus, Franklin Thomas Wright,	Bus.,	Bethlehem.
Lea, Thomas Joshua,	Ch.E.,	Trenton, N. J.
Lees, John Luther,	M.E.,	Bethlehem.
Leister, Frank Henry, Jr.,	C.E.,	North Wales.
Lester, Harry Vanderburgh,	Ch.E.,	Philadelphia.
Levanseller, George Elmer,	N.E.,	Elizabeth, N. J.
Lewis, Frederick William,	B.A.,	Pottsville.
Light, Joel Longenecker,	E.M.,	Allentown.
Light, Simon Peter, Jr.,	E.E.,	Lebanon.
Linderman, Beverly Warner,	Bus.,	Beverly, N. J.
Linderman, Stuart Henry,	Bus.,	Beverly, N. J.
Liston, James Philip,	Bus.,	Lowell, Mass.
Lock, Robert Kenneth,	B.A.,	Pittsburgh.
Lodge, Friend Horace,	C.E.,	Philadelphia.
Loeper, Bert Joseph,	E.E.,	Reading.
Lohmann, Louis John,	E.E.,	Dunmore.
Loose, Henry Troxell,	Bus.,	Allentown.
Lyons, Grant Maxwell,	B.A.,	Warren.
McCarthy, Raymond Timothy,	Bus.,	Easton.
McCloskey, George Lester,	Bus.,	Brighton, Mass.
McConnell, George,	Bus.,	Butler.
McFadden, Michael Charles Joseph,	Met.,	Bethlehem.

Linderman, Stuart Henry,	Bus.,	Beverly, N. J.
McNulty, Carrell Stewart,	C.E.,	Washington, D. C.
McPherson, John Douglas, 3d.,	E.E.,	Fair Oaks, Cal.
Magruder, Elbert Tyler,	B.A.,	Winchester, Va.
Maioriello, Anthony Joseph,	B.A.,	Bethlehem.
Major, Worth Roland,	Bus.,	Tunkhannock.
Markley, John Clemens,	Ch.E.,	Zieglersville.
MacGowan, Leonard Franklin,	M.E.,	Chesire, Conn.
Manahan, Everett Cutler,	C.E.,	Mount Vernon, N. Y.
Maynes, Robert Rusk,	Bus.,	Bethlehem.
Melniker, Edward Joseph,	B.A.,	Bayonne, N. J.
Meyer, Theodore Henry,	M.E.,	Newark, N. J.
Millar, Glenn Leroy,	B.A.,	Ensley, Ala.
Miller, Charles Heck,	Ch.E.,	Wilkes-Barre.
Minnich, Charles Raymond,	C.E.,	Robesonia.
Minnich, Joseph Pilkay,	E.E.,	Harrisburg.
Mitman, Frederick Snyder,	E.M.,	Bethlehem.
Mitman, Harry Ammon,	Ch.E.,	Northampton.
Monie, Thomas,	N.E.,	Moosic.
Monroe, William,	Bus.,	Cleveland, O.
Moyer, Joseph Fretz,	C.E.,	Quakertown.
Moyer, Robert Franklin,	C.E.,	Allentown.
Muirhead, Andrew Wilson,	M.E.,	Bridgeport, Conn.
Muschlitz, Wilbert David,	B.A.,	Bethlehem.
Nawn, Gaston,	Bus.,	Roxbury, Mass.
Neely, James Bowman,	E.M.,	New York, N. Y.
Nelson, Peter Christian, Jr.,	Ch.E.,	Mt. Lakes, N. J.
Nevins, Samuel Craig,	Ch.E.,	Tamaqua.
Nourse, Thurston George,	C.E.,	Berlin, N. J.
Nowell, William Gilbert,	Bus.,	McKeesport.
O'Donnell, Thomas Alfonsus,	B.A.,	Eckley.
O'Hearn, Edmund Francis,	M.E.,	Brookline, Mass.
O'Keefe, Francis Callistus,	Bus.,	Rockville, Conn.
Olcott, John Hedrick,	C.E.,	Glencarlyn, Va.
Old, Marcus Calvin,	B.A.,	Allentown.
Oliver, Donnell Neel,	B.A.,	Pittsburgh.
Opdycke, John Hinkle,	Bus.,	Philadelphia.
Orlando, Samuel Palella,	E.E.,	Bridgeton, N. J.
Palmer, Henry Parsons,	C.E.,	Langhorne.
P'an, Chung-Wen,	E.M.,	Hsing Cheng Hsieu, Fengtien, China.
Partin, Kenneth Woollcott,	M.E.,	Wilmington, N. C.

Passmore, Henry Etter, Jr.,	M.E.,	Columbus, O.
Patterson, Daniel Walter,	C.E.,	Doylestown.
Patterson, Robert Livingston, Jr.,	Ch.E.,	Elizabeth, N. J.
Pent, Howard Franklin,	Bus.,	Jenkintown.
Petersen, Theodore Otto,	Ch.E.,	Philadelphia.
Pezzini, Louis Joseph,	Bus.,	Pittsfield, Mass.
Pfahler, Robert Gair,	E.M.,	Wilkes-Barre.
Phifer, Jacob James,	M.E.,	Allentown.
Picht, George Christopher, Jr.,	E.E.,	Bethlehem.
Pierce, Jonathan Dorr,	Bus.,	Montclair, N. J.
Pill, Frank, Jr.,	B.A.,	Califon, N. J.
Platt, Ellis Halsted,	M.E.,	Washington, D. C.
Platt, Robert,	Ch.E.,	New York, N. Y.
Plumb, Rollo Green,	B.A.,	Bethlehem.
Polhemus, Harvey Francis,	C.E.,	South Nyack, N. Y.
Poole, Rudolph A.,	E.E.,	Sparrows Point, Md.
Portland, Charles Nicholas,	E.M.,	Pottsville.
Potts, George Eckert,	Bus.,	Reading.
Prunaret, Henri Frederick,	M.E.,	Northampton.
Quick, Donald Mott,	M.E.,	Yonkers, N. Y.
Quier, Kenneth Elwell,	M.E.,	Bethlehem.
Quigley, Raymond Joseph,	Ch.E.,	Jeddo.
Rakestraw, Theodore Horace,	E.M.,	Elizabeth, N. J.
Randall, Harradon,	C.E.,	Lykens.
Randall, Nathaniel Gilroy,	Bus.,	New York, N. Y.
Read, John Mason,	C.E.,	Washington, D. C.
Redington, Joseph Patrick,	B.A.,	Wilkes-Barre.
Regad, Eugene Desire,	E.M.,	Irvington, N. J.
Reid, Byron G.,	B.A.,	Bridgeport, Conn.
Reif, Fulmer Jacob, Jr.,	Ch.E.,	Harrisburg.
Reilly, John Kennedy,	E.M.,	Spangler.
Reiter, Irvin Sterner,	Met.,	Bethlehem.
Reynolds, Joseph Lee,	M.E.,	Dorranceton.
Rhoades, Ronald Sags,	E.M.,	Nutley, N. J.
Richards, Elmer Lincoln,	C.E.,	Somerville, N. J.
Richards, Lawrence Hamilton,	Bus.,	Pottsville.
Rieman, Edwin Frederick,	E.E.,	Tamaqua.
Riley, John Stephen,	E.E.,	Willimantic, Conn.
Roberts, Evan Emlyn,	M.E.,	Dunmore.
Robinson, Albert Edward,	Ch.E.,	New York, N. Y.

Robinson, John Bunyan,	E.M.,	Chester.
Robnett, John David, Jr.,	E.E.,	Washington, D. C.
Rodriguez, Abraham,	B.A.,	Chapparal, Tulima, Mexico.
Rodgers, Samuel Procter,	M.E.,	Baltimore, Md.
Rogers, Ernest Leo,	E.E.,	Montrose.
Roller, Oscar Frederic, Jr.,	Ch.E.,	Philadelphia.
Roney, David Martin,	Bus.,	Philadelphia.
Rotz, Harry Frederick,	Bus.,	Harrisburg.
Roth, Leonard William,	Bus.,	Melrose Park.
Rowe, Robert Elmore,	M.E.,	Redington.
Rubba, Russell,	Ch.E.,	Hammonton, N. J.
Ruger, Raymond Philip,	C.E.,	Philadelphia.
St. John, Kenneth Frederick,	C.E.,	New York, N. Y.
Sansom, Edward Marsh,	Ch.E.,	Cranford, N. J.
Saunders, Oliver Hubbard, Jr.,	M.E.,	Brooklyn, N. Y.
Schaefer, Everett Gordon,	Ch.E.,	New York, N. Y.
Schaeffer, William Jefferson,	E.E.,	Coplay.
Scheffy, Clarence George,	B.A.,	Nazareth.
Scheirer, Charles Worthington,	Ch.E.,	Jonestown.
Schifreen, Clement Solomon,	E.E.,	Catasauqua.
Schoepps, George William,	Bus.,	New York, N. Y.
Schragger, Charles Nelson,	Ch.E.,	Trenton, N. J.
Schrauff, Henry John,	C.E.,	Jersey City, N. J.
Schwab, Thomas Wesley, Jr.,	B.A.,	Bath.
Schwarzbach, Alvin August Claus,	E.M.,	Newark, N. J.
Scott, Winfield William,	Chem.,	Minersville.
Sehring, Fred George,	Ch.E.,	Joliet, Ill.
Seidel, Robert Bruce,	M.E.,	Lebanon.
Settle, Richard Torpin,	Ch.E.,	Drexel Hill.
Shaw, Hugh Curtis,	Bus.,	Tidioute.
Sheedy, Clayton McGowan,	Bus.,	Groton, Mass.
Sheetz, Olin Curtis,	Met.,	East Stroudsburg.
Sheiry, Edward Slater,	C.E.,	Washington, D. C.
Sheily, Freeman Moyer,	Bus.,	Allentown.
Shoemaker, H. E. Walter,	C.E.,	Freeland.
Shoemaker, Lewis Foulke, Jr.,	C.E.,	Lansdowne.
Shore, Richard Bailey, Jr.,	M.E.,	Crafton.
Siebecker, Walter,	Bus.,	Scranton.

Siemann, Arthur Louis,	C.E.,	Brooklyn, N. Y.
Simendinger, Kenneth Alphonse,	M.E.,	Philadelphia.
Simpson, Harold Emerson,	M.E.,	Indiana.
Smith, Leroy,	Bus.,	Allentown.
Smith, Leslie Ewart,	E.M.,	East Mauch Chunk.
Smith, Thomas Cameron,	M.E.,	Allentown.
Snavely, Shirely Ehnes,	Ch.E.,	Roanoke, Va.
Snyder, Edwin Henry, Jr.,	E.E.,	Washington, D. C.
Spindler, Henry,	M.E.,	Jersey City, N. J.
Sprague, John Frederick,	M.E.,	Raleigh, N. C.
Stafford, Samuel Alfred,	Met.,	Aliquippa.
Stanier, John Stewart,	Bus.,	Tarentum.
Stanley, Leslie Wright,	B.A.,	Williamsport.
Stanton, Thomas William,	Bus.,	Newark, N. J.
Steiner, William Joseph Henry,	Bus.,	New York, N. Y.
Stewart, Walter Preston,	B.A.,	Grand Prairie, Tex.
Stinson, Robert,	Chem.,	Norristown.
Stoll, John Howard,	Met.,	Bethlehem.
Styron, Oscar Muse, Jr.,	C.E.,	Washington, D. C.
Swayze, Burton Willis, Jr.,	M.E.,	Allentown.
Sylvan, Rolf,	Bus.,	New York, N. Y.
Talmage, Herbert Richard,	E.M.,	Irvington, N. J.
Tarbell, Theodore Hyde,	M.E.,	Vineland, N. J.
Taylor, John Wright, Jr.,	M.E.,	Century, Fla.
Taylor, Thomas Rogers,	Ch.E.,	Palmyra, N. J.
Thomas, Hopkin Buckland,	M.E.,	Catasauqua.
Thompson, William Gardiner,	B.A.,	Richmond Hill, N. Y.
Tice, Edwart Grant,	M.E.,	Bethlehem.
Todd, James Arnold,	Met.,	Doylestown.
Torpin, Richard, 3rd,	Bus.,	Ashbourne.
Trumbore, Frederick William,	M.E.,	Bethlehem.
Tullidge, George Bowler, Jr.,	M.E.,	Philadelphia.
Turner, Clarence Hutchins,	E.E.,	Schenectady, N. Y.
Tyler, William Boyd,	Bus.,	Cape May Court House N. J.
Underwood, Herbert Francis,	M.E.,	Brooklyn, N. Y.
Unger, Lee William, Jr.,	M.E.,	Clairton.
Van Billiard, Lewis Howard,	E.E.,	Bethlehem.
Van Keuren, Edwin,	B.A.,	Bethlehem.
Van Ness, John Harold,	C.E.,	Paterson, N. J.
Vogt, Charles Clinton, Jr.,	Met.,	Allentown.

Voss, Charles Abbott,	B.A.,	Bethlehem.
Walker, George Alan,	C.E.,	Flint, Mich.
Walker, Hobart Alexander, Jr.,	Bus.,	East Orange, N. J.
Walker, Stanley Beziat,	B.A.,	Baltimore, Md.
Wallace, Edward Allen, Jr.,	Bus.,	Grand Rapids, Mich.
Walter, Gilbert,	B.A.,	Woodlynne, N. J.
Walters, Frank Clayton,	B.A.,	Bethlehem.
Walton, Joseph Edward,	C.E.,	Philadelphia.
Warriner, Farnham,	Bus.,	Philadelphia.
Watrous, Jerome Anthony,	C.E.,	Forest Hills, N. Y.
Way, William Henry,	M.E.,	Coatesville.
Webb, Robert Stanford,	M.E.,	Asheville, N. C.
Wells, George Herbert, Jr.,	Ch.E.,	Brooklyn, N. Y.
Wentz, James,	Bus.,	New York, N. Y.
Werft, Ellis Lincoln,	C.E.,	Altoona.
Werner, David Thomas,	E.E.,	Lebanon.
White, Charles Curtis,	Bus.,	Haverhill, Mass.
White, Cecil Karl,	Bus.,	New York, N. Y.
Wigfall, Edward Newton, Jr.,	Ch.E.,	Philadelphia.
Wight, Donald Miller,	M.E.,	Washington, D. C.
Wilhelmi, George Oswald,	M.E.,	Maywood, N. J.
Wilkins, Paul Edwin,	C.E.,	Baltimore, Md.
Wilkins, Victor Joseph,	Bus.,	Baltimore, Md.
Willets, William Everett,	M.E.,	Manhasset, N. Y.
Wilson, Frederic William, Jr.,	E.E.,	Pocomoke, Md.
Wilson, Harry,	Ch.E.,	Bethlehem.
Wilson, Maitland Alexander,	M.E.,	Pittsburgh.
Wilson, Sering Dunham,	Bus.,	New York, N. Y.
Wilson, Samuel Marshall,	Bus.,	Glenside.
Winfree, Christopher Valentine,	M.E.,	Lynchburg, Va.
Wingate, Bruce Kuglow,	C.E.,	Reading.
Wire, Charles Raymond,	C.E.,	Washington, D. C.
Wohlsen, Theodore Oelrich,	C.E.,	Lancaster.
Wolensky, Barney Louis,	Ch.E.,	Palmerton.
Wolfe, Charles Clifford,	B.A.,	Shoemakersville.
Wood, Harold Sanford,	M.E.,	Crafton.
Woolley, Richard Downey,	E.M.,	Noble.
Woolley, William Frank, Jr.,	E.M.,	Noble.
Worth, William Harold,	E.E.,	Prospectville.
Wright, Frederic Flavel,	Bus.,	Harrisburg.
Wright, John Harvey,	M.E.,	Hazleton.

Wuethrich, Adolph Gustave,	Met.,	Perth Amboy, N. J.
Yott, George Malcolm Doge,	Bus.,	New York, N. Y.
Young, Harry Elmer,	Ch.E.,	Atlantic City, N. J.
Zantzinger, Richard Chew,	Bus.,	Washington, D. C.
Zetina, Joaquin Osorio,	M.E.,	Mexico City, Mexico.

SPECIAL STUDENTS

	Course	Residence
Aguilar, Juan Cruz,	E.M.,	Tampico, Tamps, Mexico.
Barr, Morris,	Ch.E.,	Lubar, Russia.
Beatty, Seth Keeney,	Bus.,	Wilkes-Barre.
Benz, Paul Frederick,	Ch.E.,	Haledon, N. J.
Boggs, Thomas Renwick,	Bus.,	Elkins Park.
Chu, Chin Chou,	Ch.E.,	Changsha, Hunan, China.
Chao, En Lang,	Met.,	Shanghai, Kiangsu, China.
Cordery, Eugene Dudley,	M.E.,	Hammonton, N. J.
Davies, Robert Kenneth,	E.M.,	Westfield, N. J.
Edwards, Thomas Gladden,	Ch.E.,	Wheeling, W. Va.
Fehnel, James William,	Chem.,	Bethlehem.
Goldberg, Solomon,	Chem.,	Pilwischky, Russia.
Hardy, John Forster,	M.E.,	Crafton.
Ill, Alfred Bernard,	Bus.,	Easton.
Lau, Zau-Ding,	E.M.,	Shanghai, Kiangsu, China.
Lennon, Joseph Francis,	Bus.,	Joliet, Ill.
Lewis, Arthur Wyndham,	Bus.,	Martin's Ferry, O.
Lewis, Samuel,	Chem.,	Allentown.
Lucas, Frank Mellon,	B.A.,	Mt. Carmel.
Lund, Gosse Clarence,	B.A.,	Berlin, Conn.
Lynch, Harold V.,	E.M.,	Ocean City, N. J.
MacIsaac, Kenneth,	E.M.,	New York, N. Y.
McKenzie, Carl Harry,	Bus.,	Dallas, Texas.
Ma, Chien Chung,	Ch.E.,	Samarang, Java.
Mattern, Walter I.,	C.E.,	Allentown.
Menezes, Godofredo Moraes,	C.E.,	Aracaju, Sergipe, Brazil.
Miller, Harry Bachman,	Bus.,	Bethlehem.
Nesselbush, Louis Michael,	Met.,	Buffalo, N. Y.
Parlour, Clarence Henry,	B.A.,	Allentown.

Fringle, Edward Wilkie,	Ch.E.,	Dallas, Texas.
Rhoades, Byron Elmer, Jr.,	C.E.,	Big Stone Gap, Va.
Romig, Clarence James,	E.M.,	Allentown.
Shaefer, J. M.,	C.E.,	Fairview Village.
Taylor, Arthur Nelson, Jr.,	C.E.,	Philadelphia.
Thomas, Albert Price,	Bus.,	Newburyport, Mass.
Thomas, George Clair,	B.A.,	Sunbury.
Thomas, James Clair,	B.A.,	Moosic.
Turner, Charles E.,	E.E.,	Hardin, Mont.
Wilson, John H.,	Bus.,	Albuquerque, N. M.
Wong, Chii Fun,	E.M.,	Huasiun, Kwangtung, China.
Yü, Tzu-Hsiang,	M.E.,	Shanghai, Kiangsu, China.
Zinszer, Harvey Alfred,	B.A.,	Allentown.

STUDENTS IN EXTENSION COURSES

The following list includes non-matriculated students who are pursuing collegiate or postgraduate courses from among those listed on pages 126-131 of this Register. In addition, candidates for the Master's degree who have also enrolled in such extension classes are included in the list of extension students. The letter G after the student's name indicates that the work he is pursuing is recognized to be of graduate character.

The courses in which the students are enrolled are indicated by numbers as follows: 1, General Biology; 2, Bacteriology; 3, Education, Public School Administration; 4, Education, Elementary Methods; 5, Secondary Education; 6, English Composition; 7, French; 8, Geology; 9, Industrial History of the United States; 10, European History; 11, History of Science; 12, Logic; 13, Organic Chemistry; 14, Educational Psychology; 15, Social Psychology; 16, Philosophy.

The number of students enrolled in these courses to January 30, 1920, is 131.

	Course	Residence
Allen, Dorothy,	15	Bethlehem.
Andreas, Margaret Elizabeth,	6	Hazleton.
Armpriester, Helen,	9	Harrisburg.
Asper, Elda Mae,	9	Harrisburg.
Bass, Florence E.,	3	Bethlehem.

Bachman, Charles C.,	5, 10, 15 G	Allentown.
Baker, Mary Lydia,	7, 12, 14	Bethlehem.
Baker, Elizabeth S.	9	Harrisburg.
Barker, Alice,	9	Harrisburg.
Benner, Emma Susan,	3	Bethlehem.
Blake, A. Mabel,	9	Harrisburg.
Bishop, Sara Emily,	3	Bethlehem.
Booker, Lois R.,	9	Harrisburg.
Broughal, Nellie,	4	Bethlehem.
Burkholder, Mary E.,	9	Harrisburg.
Butz, Nelson Allen,	10, 15 G	Allentown.
Carroll, Clara,	16	Bethlehem.
Carroll, John H.,	8	Easton.
Chamberlin, Mary Edna,	6	Hazleton.
Chequer, Dorothy,	16 G	Bethlehem.
Christman, Louella I.,	1, 2, 12, 14	Bethlehem.
Chubbuck, Mary Almira,	1, 2	Allentown.
Coffman, Mary,	6	Hazleton.
Drown, Ruth,	7	Bethlehem.
Dugan, Cora E.,	9	Harrisburg.
Durr, Louise A.,	8	Bethlehem.
Dyer, Mary,	4	Bethlehem.
Ely, Dora Huber,	6	Hazleton.
Fegeley, John,	13	Allentown.
Ferguson, Bertha S.,	9	Harrisburg.
Ferguson, J. Frazier,	9	Harrisburg.
Fey, Mary Wilhelmina,	6	Hazleton.
Frankenfield, Ira M.,	3	Bethlehem.
Fritsch, Warren,	5, 15 G	Allentown.
Fuerstenow, Anna,	8	Bethlehem.
Gallagher, Mary,	4	Bethlehem.
Gayman, Paul S.,	8	Easton.
Gilbert, Ida Belle,	6	Hazleton.
Goetz, G. Herman,	9	Harrisburg.
Gougler, Susan J.,	9	Harrisburg.
Griffith, Isabelle,	9	Harrisburg.
Grove, La Vere,	9	Harrisburg.
Hafner, Gertrude,	3	Bethlehem.
Hamaker, Gertrude E.,	9	Harrisburg.
Harclerode, W. M.,	9	Harrisburg.
Harlacher, J. E.,	9	Harrisburg.
Heberling, Ella,	3	Bethlehem.

Heckman, Elsie,	15	Allentown.
Heckman, Miriam Mildred,	1, 2	Allentown.
Heffner, Esther Louise,	1, 2, 11	Allentown.
Heiges, W. C.,	9	Harrisburg.
Heine, Rose,	4	Bethlehem.
Hemsath, Annie Elizabeth,	3	Bethlehem.
Herritt, Olive Louise,	6	Hazleton.
Hocker, P. L.,	9	Harrisburg.
Hofford, Hilda,	16	Allentown.
Hook, Clara H.,	9	Harrisburg.
Huber, Katherine F.,	9	Harrisburg.
Hummer, Miles C.,	9	Harrisburg.
Jones, Harold Scott,	1, 2, 3	Bethlehem.
Keiter, Annie I.,	9	Harrisburg.
Kern, Nelson E.,	10, 15 G	Allentown.
Kessler, Rose M.,	10	Allentown.
Keys, Adelaide,	9	Camp Hill.
Knox, Elizabeth S.,	9	Harrisburg.
Koh, John F.,	9	Harrisburg.
Koons, Carrie Elizabeth,	1, 2	Allentown.
Krall, Helen,	9	Harrisburg.
Krause, Blanche,	4	Bethlehem.
Kressler, Ray H.,	5, 10, 15 G	Allentown.
Lawrie, Annie K.,	9	Harrisburg.
Leaman, Ruth,	5	Allentown.
Leh, Myrtle,	1	Fountain Hill.
Lewis, Alfred Charles,	10	Allentown.
Lindsay, Alexander M.,	9	Harrisburg.
Lubrecht, Anna,	6	Hazleton.
McCullough, Harry Rath,	5, 10, 15 G	Allentown.
McFarlane, Emma May,	6	Hazleton.
Maeder, Edna M.,	9	Dauphin.
Markel, Ella Evelyn,	1, 2	Easton.
Melville, Claudine,	9	Harrisburg.
Miller, Dorothy,	1, 2, 15	Easton.
Murray, Anna Victoria,	3, 4	Bethlehem.
Murray, Marion,	7	Bethlehem.
Myers, Carrie E.,	9	Harrisburg.
Noll, Elizabeth,	6	Hazleton.
Nolf, Laura,	3	Center Valley.
O'Donnell, Catherine Clare,	6	Hazleton.
Oberlin, Margaret,	9	Harrisburg.

Orth, Carrie L.,	9	Harrisburg.
Owen, Bessie,	6	Hazleton.
Patterson, Arthur C.,	3, 15	Bethlehem.
Pierce, Lydia Baker,	16 G	Allentown.
Pohl, Elizabeth Shimer,	1, 2	Easton.
Pomp, William H.,	9	Harrisburg.
Reen, Sarah K.,	9	Bethlehem.
Reinbold, Morgan D.,	1, 2, 3	Bethlehem.
Ripple, Martha Matilda,	6	Hazleton.
Rishel, Dorothy,	9	Harrisburg.
Rose, Edward G.,	9	New Cumberland.
Ryan, Julia,	9	Harrisburg.
Serfass, Lillian,	4	Fountain Hill.
Schaeffer, Emma,	6	Hazleton.
Schumaker, John G.,	13	Allentown.
Sheaffer, J. L.,	1, 2, 3 G	Northampton.
Strohmeier, Adella,	8	Easton.
Stumpf, Lena,	6	Hazleton.
Sullivan, Margaret,	9	Harrisburg.
Tack, Sarah A.,	9	Harrisburg.
Thomas, George Edward,	10, 15 G	Allentown.
Thomas, M. H.,	9	Harrisburg.
Tinker, William Marsh,	5, 10, 15 G	Allentown.
Tittle, A. May,	9	Harrisburg.
Tittle, Elizabeth,	9	Harrisburg.
Turner, Elinor,	4	Bethlehem.
Van Dyke, Ella Rebecca,	3	Bethlehem.
Villee, Sallie,	3	Bethlehem.
Wallick, Raymond G.,	1, 2, 3, 12	Bethlehem.
Wantzel, Dorothy,	16	Bethlehem.
Weil, Emma Catherine,	3	Bethlehem.
Weimer, John H.,	15	Allentown.
Weirbach, T. Mahlon,	5, 10, 15 G	Allentown.
Weirick, Iva C.,	9	Harrisburg.
White, Estelle Grace,	6	Hazleton.
Williams, Ada Jane,	6	Hazleton.
Williams, J. Henry,	9	Harrisburg.
Wuchter, Miriam H.,	16	Allentown.
Yellis, Harriet,	4, 15	Allentown.
Ziegenfuss, Warren Allen,	5, 10, 15 G	Allentown.
Zimmerman, Annie M.,	9	Harrisburg.
Zimmerman, George Wentling,	5, 10 G	Allentown.

SUMMARY OF STUDENTS BY CLASSES AND COURSES

	* Graduates	Seniors	Juniors	Sophomores	Freshmen	Specials	Totals
Arts & Science	35	13	14	12	68	6	148
Business.....	3	8	12	25	84	9	141
Civil Eng.....	4	24	35	38	61	5	167
Mech. Eng.....	2	28	24	36	74	3	167
Mining Eng....	6	16	18	26	38	7	111
Metal. Eng.....	10	6	8	25	20	2	71
Electromet.....		12	10				22
Electric. Eng...	6	19	13	28	52	1	119
Chemistry.....	5	1	2	2	2	3	15
Chem. Eng.....	4	21	36	43	46	6	156
Naval Eng.....				12	7		19
Totals.....	75	148	172	247	452	42	1136

*Graduate students are listed in the department in which they are taking their major subject.

GEOGRAPHICAL SUMMARY OF STUDENTS

Alabama	5
California	2
Connecticut	21
District of Columbia	45
Florida	5
Illinois	8
Indiana	6
Kentucky	2
Louisiana	1
Maine	1
Maryland	35
Massachusetts	26
Michigan	4
Missouri	3
Montana	1
New Jersey	159
New Mexico	1
New York	93
North Carolina	5
Ohio	22
Oklahoma	1
Pennsylvania	620
Rhode Island	5
South Carolina	1
Tennessee	3
Texas	1
Utah	1
Vermont	1
Virginia	15
West Virginia	6
Wisconsin	1
Brazil	3
China	16
Cuba	2
Dutch East Indies	1
Hawaii	1
Honduras	1
Japan	1
Java	1
Mexico	5
Porto Rico	1
Russia	2
Siam	1
Venezuela	1
	1136

INDEX

Administrative Officers, 15.
Admission of Students, 17, 30.
  Requirements, 17–19.
Advanced Standing, Admission to, 28.
Almanac, 2.
Alumni Association, 167
Alumni Prizes, 168.
  Award in 1919, 160.
Alumni Prizes for Oratory, 168.
Arboretum, 157.
Arts and Science Club, 158.
Arts and Science, College of
  Description, 31.
  Requirements for admission, 17.
  Schedules of studies, 33–37.
  Undergraduate courses, 76.
Assistant Professors, 9.
Associate Professors, 9.
Astronomy
  Graduate courses, 133.
  Observatory, 153.
  Undergraduate courses, 90.
Athletic Field, 156.
Biology
  Graduate courses, 139.
  Undergraduate courses, 105
Buildings, 144.
Business Administration, College of
  Description, 38.
  Requirements for admission, 18.
  Schedule of studies, 41.
  Undergraduate courses, 77.
Calendar, 3.
Callender Fellowship, 166.
Carson Prize, 167.
  Award in 1919, 160.
Certificates, 30.
Chemical and Metallurgical Laboratories, 140.
Chemical Engineering, Course in
  Description, 68.
  Requirements for admission, 19.
  Schedule of studies, 73.
Chemistry, Course in
  Description, 65.
  Graduate courses, 140.
  Requirements for admission, 19.
  Schedule of studies, 67.
  Undergraduate courses, 116.
Christmas Hall, 152.
Civil Engineering, Course in
  Description, 42.
  Graduate courses, 141.
  Requirements for admission, 19.
  Schedule of studies, 45.
  Undergraduate courses, 91.
College Commons, 155.
Committee on Admission, 15.
Conference Department, 14, 125.
Coppee Hall, 152.
Coxe Memorial Fund, 166.
Coxe Memorial Library, 154.
Coxe Mining Laboratory, 150.
Departmental Societies, 159.
Dormitories, 154.
Drown Memorial Hall, 155
Du Pont Fellowship, 166.
Economics
  Graduate courses, 134
  Undergraduate courses, 77.
Economic Geography, 81.
Education
  Graduate courses, 139.
  Undergraduate courses, 77.
Electrical Engineering, Course in
  Description, 60.
  Graduate courses, 134.
  Requirements for admission, 19
  Schedule of studies, 64.
  Undergraduate courses, 111.
Engineering Societies, 158.
English
  Graduate courses, 134.
  Undergraduate courses, 88
Examinations, Entrance, 27.
  Examinations at schools, 30.
Expenses, 143.
Extension Courses, 126.
Faculty, 6.
Forestry, 105.
Founder's Day, 159
Frazier and Ringer Memorial Fund
  173.
Fritz Engineering Laboratory, 150.
French
  Graduate courses, 138.
  Undergraduate courses, 86.
Geology
  Graduate courses, 138.
  Undergraduate courses, 102.
German
  Graduate courses, 137.
  Undergraduate courses, 85.
Graduate Courses
  Admission to, 30, 132,
  List, 133.
Greek
  Graduate courses, 134
  Undergraduate courses, 83
Gymnasium
  Description, 155.
  Physical education, 124
Haines Scholarship, 165.
History
  Graduate courses, 134.
  Undergraduate courses, 81.
Honor List, 1919, 160
Honor System, 159.
Honorary Scholarship Societies, 158.

Instructors, 11.
Italian, 88.
Latin
Graduate courses, 134.
Undergraduate courses, 82.
Lectures, 158.
Lecturers, 9.
Library
University Library, 154.
Officers of, 15.
Coxe Memorial Library, 154.
List of Studies
Graduate courses, 132.
Undergraduate courses, 76.
Mathematics
Graduate courses, 133.
Undergraduate courses, 90.
Mechanical Engineering, Course in
Description, 46.
Requirements for admission, 19.
Schedule of studies, 49.
Undergraduate courses, 95.
Mercur Scholarships, 165.
Metallurgical Engineering, Course in
Description, 51.
Graduate courses, 136.
Requirements for admission, 19.
Schedule of studies, 50.
Undergraduate courses, 99.
Military Science and Tactics, 121.
Mining Engineering, Course in
Description, 54.
Graduate courses, 137.
Requirements for admission, 19.
Schedule of studies, 59.
Undergraduate courses, 108.
Museums, 157.
Observatory, 153.
Packer Hall, 144.
Packer Memorial Church, 15.
Description, 153.
Services, 159.
Philosophy
Graduate courses, 139.
Undergraduate courses, 77.
Physical Education, 124.
Physical Laboratory, 145.
Physics
Graduate courses, 141.
Undergraduate courses, 110.
Political Science, 80.
Portuguese, 87.
Pre-Medical Courses, 35.
Price Hall, 155.
Price Prize, 167.
Prickitt Scholarship, 165.
Prizes
Alumni Prizes, 168.
Carson Prize, 167.
Price Prize, 167.
Wilbur Prizes, 167.
Williams Prizes, 170.
Professors, 6.
Psychology
Graduate courses, 139.
Undergraduate courses, 76.
Romance Languages, 86.
Saucon Hall, 152.
Sayre Observatory, 153.
Sayre Park, 157.
Scholarships
Coxe Memorial Fund, 166.
Du Pont Scholarship, 166.
Haines Scholarship, 165.
Mercur Scholarships, 165.
Prickitt Scholarship, 165.
Wilbur Scholarship, 165.
Williams Fund, 166.
Ship Construction and Marine Transportation, Course in
Description, 73.
Requirements for admission, 19.
Schedule of studies, 75.
Undergraduate courses, 119.
Site of the University, 143.
Spanish, 87.
Students, List of, for 1919–1920, 171.
Graduate Students, 174.
Seniors, 178.
Juniors, 182.
Sophomores, 186.
Freshmen, 192.
Special Students, 204.
Extension Course Students, 205.
Summary of Students:
By Classes and Courses, 209.
By Geographical representation, 210.
Studies, List of, 76.
Summer Terms, 131.
Taylor Field, 156.
Taylor Gymnasium, 155.
Taylor Hall, 154.
Teachers' Courses, 37, 126.
Theses, 159.
Trustees, 4.
Committees, 5.
Honorary Alumni Trustees, 4.
Officers of the Board, 5.
Tuition, 142.
Undergraduate Courses, 77.
University Day, 160.
University Sunday, 159.
Wilbur Engineering Laboratory, 147.
Wilbur Prizes, 167.
Award in 1919, 160.
Wilbur Scholarship, 165.
Award in 1919, 160.
Williams Fund, 166.
Williams Hall, 148.
Williams Prizes, 170.
Y. M. C. A., 159.

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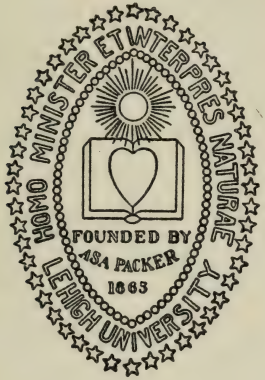

1920-1921

BETHLEHEM

PENNSYLVANIA

1920

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CALENDAR

1920	1920—1921
Sept. 17, 18, 20, 21, (Friday, Saturday, Monday, Tuesday)	Examinations for admission.
Sept. 22, 3.30 P.M., (Wednesday)	First term begins.
Oct. 2, (Saturday)	Founder's Day.
Nov. 25, (Thursday)	Thanksgiving holiday.
Dec. 18, 12 M., (Saturday)	Christmas holidays begin.
1921	
Jan. 3, 7.45 A.M., (Monday)	Christmas holidays end.
Jan. 28, 8.00 A.M., (Friday)	Examinations begin.
Feb. 4, 5.00 P.M., (Friday)	Examinations end.
Feb. 7, 7.45 A.M., (Monday)	Second term begins.
Feb. 22, (Tuesday, Washington's Birthday)	Junior Oratorical Contest.
April 23, 12.00 M., (Saturday)	Spring vacation begins.
May 2, 7.45 A.M., (Monday)	Spring vacation ends.
May 30, 8.00 A.M., (Monday)	Senior examinations begin.
June 1, 8.00 A.M., (Wednesday)	Other examinations begin.
June 8, 5.00 P.M., (Wednesday)	Examinations end.
June 11, (Saturday)	Alumni Day.
June 12, (Sunday)	Baccalaureate Sunday.
June 13, (Monday)	Class Day.
June 14, (Tuesday)	University Day.
June 15, (Wednesday)	Summer term begins.
June 15, 16, 17, 18, (Wednesday, Thursday, Friday, Saturday)	Examinations for admission.

1921	1921—1922
Sept. 16, 17, 19, 20, (Friday, Saturday, Monday, Tuesday)	Examinations for admission.
Sept. 21, 3.30 P.M., (Wednesday)	First term begins.
Oct. 1, (Saturday)	Founder's Day.
Nov. 24, (Thursday)	Thanksgiving holiday.
Dec. 17, 12.00 M., (Saturday)	Christmas holidays begin.
1922	
Jan. 2, 7.45 A.M. (Monday)	Christmas holidays end.
Jan. 27, 8.00 A.M., (Friday)	Examinations begin.
Feb. 3, 5.00 P.M., (Friday)	Examinations end.
Feb. 6, 7.45 A.M., (Monday)	Second term begins.
Feb. 22, (Wednesday, Washington's Birthday)	Junior Oratorical Contest.
April 22, 12.00 M., (Saturday)	Spring vacation begins.
May 1, 7.45 A.M., (Monday)	Spring vacation ends.
May 29, 8.00 A.M., (Monday)	Senior examinations begin.
May 31, 8.00 A.M., (Wednesday)	Other examinations begin.
June 7, 5.00 P.M., (Wednesday)	Examinations end.
June 10, (Saturday)	Alumni Day.
June 11, (Sunday)	Baccalaureate Sunday.
June 12, (Monday)	Class Day.
June 13, (Tuesday)	University Day.
June 14, (Wednesday)	Summer term begins.
June 14, 15, 16, 17, (Wednesday, Thursday, Friday, Saturday)	Examinations for admission.

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456 Montclair Avenue

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405 Center Street

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WILLIAM L. ESTES, A.M., M.D.
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537 Center Street

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GEORGE C. BECK, A.C.
Assistant Professor of Quantitative Analysis
411 Cherokee Street

SYLVANUS A. BECKER, C.E., M.S.
Assistant Professor of Civil Engineering
3 East North Street

JOSEPH B. REYNOLDS, B.A., M.A., PH.D.
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721 West Broad Street

ROBERT P. MORE, B.A., M.A.
Assistant Professor of German
1830 Main Street

HOWARD M. FRY, E.E., M.S.
Assistant Professor of Physics
726 Avenue H

RAYMOND WALTERS, B.A., M.A.
Assistant Professor of English
333 East North Street

RALPH L. BARTLETT, S.B., M.S.
Assistant Professor of Mining Engineering
35 West Northampton Street

MERTON O. FULLER, C.E.
Assistant Professor of Civil Engineering
723 Avenue H

JOHN MILTON TOOHY, B.A., M.A.
Assistant Professor of Romance Languages
7 West Broad Street

J. LYNFORD BEAVER, E.E.
Assistant Professor of Electrical Engineering
14 East Market Street

LEGRAND REX DROWN, B.S., M.A.
Assistant Professor of Education
420 Cherokee Street

HOMER G. TURNER, B.S., M.S.
Assistant Professor of Geology
1408 North Wood Street

HOWARD DIETRICH GRUBER, E.E.
Assistant Professor of Electrical Engineering
123 Highland Avenue, Rosemont

PARKE B. FRAIM, E.M., M.S.
Assistant Professor of Physics
328 West Fourth Street

MORRIS S. KNEBELMAN, B.S., M.S.
Assistant Professor of Mathematics
415 Cherokee Street

HARRY C. PAYROW, B.S. IN C.E.
Assistant Professor of Civil Engineering
1133 Main Street

J. STANLEY BEAMENSDERFER, A.B., A.M., M.E.
Assistant Professor of Mechanical Engineering
317 Avenue H

OVID W. ESHBACH, E.E.
Assistant Professor of Electrical Engineering
1628 West Broad Street

ALLISON BUTTS, A.B., S.B.
Assistant Professor of Metallurgy
1704 West North Street, Rosemont

WALTER F. QUAST, M.E.
Assistant Professor of Mechanical Engineering
712 Turner Street, Allentown

A. HENRY FRETZ, PH.B., C.E.
Assistant Professor of Geology
400 Reeder Street, Easton

FREDERICK J. LEWIS, B.S.
Assistant Professor of Civil Engineering
1239 Russell Avenue

HARRIE B. PULSIFER, B.S. IN CH.E.
Assistant Professor of Metallurgy
621 Dunn Street

WARREN W. EWING, B.S., PHD.
Assistant Professor of Physical Chemistry
631 North New Street

CHARLES A. SHAMOTULSKI, CAPT. INF., U. S. A.
Assistant Professor of Military Science and Tactics
629 Avenue N

GEORGE B. CURTIS, B.A., B.S.
Assistant Professor of Economics
913 Linden Street

INSTRUCTORS

EDWARD C. ROEST, M.A.
Instructor in German
232 Wall Street

FAY C. BARTLETT
Instructor in Physical Education
219 East Packer Avenue

PEYSAH LEYZERAH, PH.D.
Instructor in Mathematics
478 Birkel Avenue

WAYNE HANLEY CARTER, B.S. IN CHEM.
Instructor in Quantitative Analysis
618 Avenue M

ROBERT E. MARTIN, B.A.
Instructor in Physics
414 West Market Street

HAROLD V. ANDERSON, B.CH.E.
Instructor in Chemistry
Franklin Avenue, Rosemont

EUGENE H. UHLER, C.E.
Instructor in Civil Engineering
924 Monroe Avenue

C. D. MACGREGOR, A.M., LL.B.
Instructor in History and Political Science
442 Webster Street

MARVIN R. SOLT, B.S.
Instructor in Mathematics
129 West Fourth Street

ROBERT N. TAYLOR, PH.B., B.S.
Instructor in Physics
704 Dakota Street

WILLIAM A. LAMBERT, B.A., M.A.
Instructor in English
921 South Eighth Street, Allentown

GEORGE F. NORDENHOLT, M.E.
Instructor in Mechanical Engineering
14 East Hickory Street

ANDREW J. NICHOLAS, M.E.
Instructor in Physics
226 Warren Square

JOSEPH J. CANONICO, A.B.
Instructor in Romance Languages
511 Seminole Street

AUGUST CONCILIO, E.E.
Instructor in Physics
536 Montclair Avenue

BOYD R. EWING, B.A.
Instructor in Romance Languages
34 North Ninth Street, Allentown

CLYDE R. FLORY, B.A.
Instructor in Biology
318 West Packer Avenue

JESSE E. GRAHAM, 1st Lieut. Inf., U. S. A.
Instructor in Military Science and Tactics
41 West Church Street

CHARLES E. LAWALL, jr., E.M.
Instructor in Geology, (Second term)
519 Kurtz Street, Catasauqua

MALCOLM KEE BUCKLEY
Assistant in Chemistry
338 Wyandotte Street

HARVEY A. ZINSZER
Assistant in Physics
235 North West Street, Allentown

JUDSON G. SMULL, B.S.
Assistant in Chemistry
106 East Northampton Avenue

MORRIS E. KANALY
Assistant in Physical Education
659 Locust Street

HOWARD S. BUNN, B.A.
Assistant in Mathematics
University Park

CLEMSON H. WARD
Assistant in Chemistry
315 West Cherokee Street

I. BARTHOLD BARBEHENN, B.S.
Assistant in Chemistry
150 West Broad Street

JOHN J. EARLY, B.S. IN CHEM.
Assistant in Chemistry
8 West Church Street

HARRY G. LARSON
Assistant in Mining Drawing
414 Cherokee Street

WILLIAM L. ESTES, JR., B.A., M.D.
Consulting Physician
819 St. Luke's Place

CONFERENCE DEPARTMENT

Director
PROFESSOR LAMBERT

Mathematics, PROFESSOR LAMBERT
Modern Languages, PROFESSOR PALMER
Physics, PROFESSOR MACNUTT
Chemistry, PROFESSOR ULLMANN

ADMINISTRATIVE OFFICERS

HENRY S. DRINKER, *President*
NATT M. EMERY, *Vice-President*
CHARLES L. THORNBURG, *Secretary of the Faculty*
JOHN L. STEWART, *Director of the Library*
FREDERICK R. ASHBAUGH, *Bursar*
RAYMOND WALTERS, *Registrar*

The offices of the President, the Vice-President, the Secretary of the Faculty, and the Registrar are in Packer Hall. The office of the Bursar is in Drown Memorial Hall.

OTHER OFFICERS

J. CLARENCE CRANMER, *Superintendent of Buildings and Grounds*
JOHN D. HARTIGAN, *Master Mechanic*
GEORGE B. MATTHEWS, *Steward of the College Commons; in charge of Dormitories and Drown Memorial Hall*

COMMITTEE ON ADMISSION

PROFESSORS THORNBURG, THAYER, STEWART, BLAKE, GOODWIN, PALMER, FOX

LIBRARY

Director
JOHN L. STEWART, A.B., PH.B.
678 Ostrum Street

Assistant Librarian
PETER F. STAUFFER
519 Wyandotte Street

PACKER MEMORIAL CHURCH

Chaplain
REV. ARTHUR MURRAY, B.A.*
835 Lynn Street

Organist
T. EDGAR SHIELDS, A. A. G. O.
4 East Church Street

* Resigned February 1, 1921.

LEHIGH UNIVERSITY

Lehigh University was chartered by the Legislature of Pennsylvania by act dated February 9, 1866. In 1865 the Hon. Asa Packer, of Mauch Chunk, inaugurated a movement to provide an institution that would afford training and education in the learned professions as then recognized, and in technical branches, the importance of which was then just becoming apparent in the development of the industrial and transportation interests of the country. He made an initial donation of $500,000 and of a large tract of land for this purpose, to which he added largely during his lifetime and by his will.

Since its foundation the equipment and resources of the University have steadily increased due to the continued interest of the University's trustees, alumni and friends. The present endowment totals three million dollars. The first important addition to the University's original plant was the Sayre Observatory, donated in 1869 by Robert H. Sayre, of Bethlehem. Later donations include Packer Memorial Church, 1887; Williams Hall, 1902; Drown Memorial Hall, 1907; the University Commons, 1907; the Wilbur Heating Plant and Engineering Laboratory, 1907; Taylor Hall, 1907; Sayre Park, 1909; Coxe Mining Laboratory, 1910; Fritz Engineering Laboratory, 1910; Taylor Gymnasium and Taylor Field, 1913.

Lehigh University offers the following courses:

COLLEGE OF ARTS AND SCIENCE:

1. The Course in Arts and Science.

COLLEGE OF BUSINESS ADMINISTRATION:

1. The Course in Business Administration.

COLLEGE OF ENGINEERING:

1. The Course in Civil Engineering.
2. The Course in Mechanical Engineering.
3. The Course in Metallurgy.
4. The Course in Mining Engineering.
5. The Course in Electrical Engineering.
6. The Course in Chemistry.
7. The Course in Chemical Engineering.
8. The Course in Ship Construction and Marine Transportation.

Courses are described in detail on pages 31 to 75.

REQUIREMENTS FOR ADMISSION

Candidates for admission to Lehigh University must be at least sixteen years of age, must present testimonials of good moral character, and must be qualified in the entrance subjects as enumerated below.

THE COLLEGE OF ARTS AND SCIENCE

(a) Candidates for admission must present entrance requirements as follows:*

	Units
English,	3
History,	1
Elementary Algebra, A and B,	1½
Plane Geometry,	1
Latin A and B or German A or French A or Spanish A,	2
	8½

(b) Candidates must present besides the subjects in (a), 6½ units from the following:

	Units
Advanced Algebra,	½
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
Latin,	2, 3 or 4
French,	1, 2 or 3
German,	1, 2 or 3
Spanish,	1, 2 or 3
American History,	1
Ancient History,	1
Modern History,	1
English History,	1
Physics,	1
Chemistry,	1
Zoölogy,	1
Botany,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Unassigned,	½ or 1

Detailed information concerning these subjects is given on pages 20 to 27.

*A unit represents a year's study in any subject in a secondary school, constituting approximately a quarter of a full year's work. A four-year secondary school curriculum should be regarded as representing not more than sixteen units of work.

THE COLLEGE OF BUSINESS ADMINISTRATION

(a) Candidates must present the following subjects:

	Units
English,	3
History,	1
Elementary Algebra, A and B,	1½
Plane Geometry,	1
German A or French A or Spanish A or Latin A and B,	2
	8½

(b) Candidates must present besides the subjects in (a), 5½ units from the following:

	Units
Advanced Algebra,	½
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
Latin,	2, 3 or 4
French A or German A or Spanish A,	2
American History,	1
Ancient History,	1
Modern History,	1
English History,	1
Freehand Drawing,	½
Mechanical Drawing,	½
Physics,	1
Elementary Chemistry,	1
Zoölogy,	½ or 1
Botany,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Manual Training,	½ or 1
Bookkeeping, Stenography and Typewriting,	1 or 2
Industrial History,	1
Civics,	1
Economics,	1
Sociology,	1
Commercial Geography,	1

Detailed information concerning these subjects is given on pages 20 to 27.

THE COLLEGE OF ENGINEERING

(a) Candidates for admission to the Courses in Civil Engineering, Mechanical Engineering, Metallurgical Engineering, Mining Engineering, Electrical Engineering, Chemistry, Chemical Engineering, and Ship Construction and Marine Transportation must present the following subjects:

	Units
English,	3
History,	1
Elementary Algebra, A and B,	1½
Plane Geometry,	1
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
German A or French A or Spanish A,	2
	9½

(b) Candidates must present besides the subjects in (a), 4½ units from the following:

	Units
Advanced Algebra,	½
Latin,	2, 3 or 4
Greek,	2 or 3
German,	2 or 3
French,	2 or 3
Spanish,	2 or 3
American History,	1
Ancient History,	1
Modern History,	1
English History,	1
Freehand Drawing,	½
Mechanical Drawing,	½
Physics,	1
Elementary Chemistry,	1
Zoölogy,	½ or 1
Botany,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Manual Training,	½ or 1

Detailed information concerning these subjects is given on pages 20 to 27.

The detailed requirements in the various subjects are as follows:

ENGLISH

Preparation in English has three main objects: (a) command of correct and clear English, spoken and written; (b) ability to use the vernacular with accuracy and appreciation; and (c) some acquaintance with the simpler English classics.

ENGLISH GRAMMAR AND COMPOSITION. The first two objects require instruction in grammar and composition. English grammar should be reviewed in the secondary school; and correct spelling and grammatical accuracy should be rigorously exacted in connection with all written work during the four years. The principles of English composition governing punctuation, the use of words, paragraphs, and the different kinds of composition, including letter writing, should be thoroughly mastered; and practice in composition, oral as well as written, should extend throughout the secondary school period. Written exercises may well comprise narration, description, and easy exposition based upon the principles of elementary rhetoric, as given in any approved High School Rhetoric. It is advisable that subjects for this work be taken from the student's personal experience, general knowledge, and studies other than English, as well as from his reading in literature. Finally, special instruction in language and composition should be supported by concerted efforts of teachers in all branches to cultivate in the student the habit of using good English in his recitations and various exercises, whether oral or written, making every recitation in some degree an exercise in English.

LITERATURE. The third object is sought by means of two lists of books, headed respectively *reading* and *study;* from which may be framed a progressive course in literature covering four years. In connection with both lists, the student should be trained in reading aloud and be encouraged to commit to memory some of the more notable passages both in verse and in prose.

The books for reading and study are to be selected from the groups suggested by the Conference on Uniform Entrance Requirements in English. 3 units.

HISTORY

The requirement in History is based on the recommendation of the Committee of Seven of the American Historical Association.

ANCIENT HISTORY, with special reference to Greek and Roman History, and including also a short introductory study of the more ancient nations and the chief events of the early Middle Ages, down to the death of Charlemagne (814). 1 unit.

MEDIAEVAL AND MODERN EUROPEAN HISTORY, from the death of Charlemagne to the present time. 1 unit.

ENGLISH HISTORY, with due reference to social and political development. 1 unit.

AMERICAN HISTORY AND CIVIL GOVERNMENT, with due reference to social and political development. 1 unit.

The examinations in history will be so framed as to require comparison and the use of judgment on the pupil's part rather than the mere use of memory. The examinations will presuppose the use of good text-books, collateral reading, and practice in written work. Geographical knowledge will be tested by requiring the location of places and movements on an outline map. 1 unit.

MATHEMATICS

ELEMENTARY ALGEBRA, A (ALGEBRA TO QUADRATICS). The four fundamental operations for rational algebraic expressions. Factoring, determination of highest common factor and lowest common multiple by factoring. Fractions, including complex fractions, and ratio and proportion. Linear equations, both numerical and literal, containing one or more unknown quantities. Problems depending on linear equations. Radicals, including the extraction of the square root of polynomials and of numbers. Exponents, including the fractional and negative. 1 unit.

ELEMENTARY ALGEBRA, B (QUADRATICS AND BEYOND). Quadratic equations, both numerical and literal. Simple cases of equations with one or more unknown quantities, that can be solved by the methods of linear or quadratic equations. Problems depending on quadratic equations. The binomial theorem for positive integral exponents. The formulas for the nth term and the sum of the terms of arithmetic and geometric progressions with applications. ½ unit.

ADVANCED ALGEBRA. Permutations and combinations, limited to simple cases. Complex numbers, with graphical representation of sums and differences. Determinants, chiefly of the second, third, and fourth orders, including the use of minors and the solution of linear equations. Numerical equations of higher degree, and so much of the theory of equations, with graphical methods, as is necessary for their treatment, including Descarte's rule of sign and Horner's method, but not Sturm's functions or multiple roots. ½ unit.

PLANE GEOMETRY. The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas; regular polygons and the measurements of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of line and plane surfaces. 1 unit.

SOLID GEOMETRY. The usual theorems and constructions of good text-books, including the relations of planes and lines in space; the properties and measurements of prisms, pyramids, cylinders and cones; the sphere and the spherical triangle. The solution of numerous original exercises, including loci problems. Application to the mensuration of surfaces and solids. ½ unit.

PLANE TRIGONOMETRY. Definitions and relations of the six trigonometric functions as ratios; circular measurement of angles. Proofs of principal formulas, in particular for the sine, cosine, and tangent of the sum and the difference of two angles, of the double angle and the half angle, the product expressions for the sum or the difference of two sines or of two cosines, etc.; the transformation of trigonometric expressions by means of these formulas. Solution of trigonometric equations of a simple character. Theory and use of logarithms (without the introduction of work involving infinite series). The solution of right and oblique triangles and practical applications. Candidates must bring their logarithmic tables to the examination. ½ unit.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of the metric system.

PHYSICS

The course of instruction in Physics should include:

(a) The study of some standard text-book, for the purpose of obtaining a connected view of the subject; (b) instruction by lecture table demonstrations, to be used mainly for illustration of the facts and phenomena of physics; (c) individual laboratory work consisting of at least thirty experiments.

The aim of laboratory work should be to supplement the pupil's fund of concrete knowledge and to cultivate his power of accurate practice, and clearness of thought and expression. The exercises should be chosen with a view to furnishing forceful illustrations of the fundamental principles and their practical applications. They should be such as to yield results capable of ready interpretation, obviously in conformity with theory, and free from the disguise of unintelligible units.

1 unit.

GERMAN

ELEMENTARY GERMAN, A. This requirement follows, in the main, the recommendation of the Committee of Twelve of the Modern Language Association. It is expected that two whole years will be given to the work.

During the first year the work should comprise:

1. Careful drill in pronunciation.

2. The memorizing and frequent repetition of easy colloquial sentences.

3. Drill upon the rudiments of grammar, that is, upon the inflection of the articles, of such nouns as belong to the language of every-day life, of adjectives, pronouns, weak verbs and the more usual strong verbs; also upon the use of the more common prepositions, the simpler uses of the modal auxiliaries and the elementary rules of syntax and word-order.

4. Abundant easy exercises, designed not only to fix in mind the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression.

5. Reading of from 75 to 100 pages of graduated texts from a reader, with constant practice in translating into German easy variations upon sentences selected from the reading lesson (the teacher giving the English), and in the reproduction from memory of sentences previously read.

During the second year the work should comprise:

1. The reading of from 150 to 200 pages of literature in the form of easy stories and plays.

2. Accompanying practice, as before, in the translation into German of easy variations upon the matter read and in the off-hand reproduction, sometimes orally and sometimes in writing, of the substance of short and easy selected passages.

3. Continued drill in the rudiments of the grammar, directed to the ends of enabling the pupil, first, to use his knowledge with facility in the formation of sente[illegible] secondly, to state his knowledge correctly in th[illegible]ns and con[illegible]cal language of grammar. [illegible]ral pron[illegible] 2 units.

[illegible]e measu[illegible]

INTERMEDIATE GERMAN. This work should comprise, in addition to the elementary course, the reading of about 400 pages of moderately difficult prose and poetry, with constant practice in giving, sometimes orally and sometimes in writing, paraphrases, abstracts, or reproductions from memory of selected portions of the matter read; also grammatical drill upon the less usual strong verbs, the use of articles, cases, auxiliaries of all kinds, tenses and modes (with special reference to the infinitive and the subjunctive), and likewise upon word order and word formation. 1 unit.

FRENCH

ELEMENTARY FRENCH, A. This requirement follows, in the main, the recommendation of the Committee of Twelve of the Modern Language Association. It is expected that two whole years will be given to the work.

During the first year the work should comprise:

1. Careful drill in pronunciation.

2. The rudiments of grammar, including the inflection of the regular and the more common irregular verbs, the plural of nouns, the inflection of adjectives, participles and pronouns; the use of personal pronouns, common adverbs, prepositions and conjunctions; the order of words in the sentence and the elementary rules of syntax.

3. Abundant easy exercises, designed not only to fix in the memory the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression.

4. The reading of from 100 to 175 pages of graduated texts, with constant practice in translating into French easy variations of the sentences read (the teacher giving the English), and in reproducing from memory sentences previously read.

5. Writing French from dictation.

During the second year the work should comprise:

1. The reading of from 250 to 400 pages of easy modern prose in the form of stories, plays or historical or biographical sketches.

2. Constant practice, as in the previous year, in translating into French easy variations upon the texts read.

3. Frequent abstracts, sometimes oral and sometimes written, of portions of the text already read.

4. Writing French from dictation.

5. Continued drill upon the rudiments of grammar, with constant application in the construction of sentences.

6. Mastery of the forms and uses of pronouns, pronominal adjectives, of all but the rare irregular verb forms, and of the simpler uses of the conditional and subjunctive. 2 units.

INTERMEDIATE FRENCH, B. This should comprise the reading of from 400 to 600 pages of French of ordinary difficulty, a portion to be in the dramatic form; constant practice in giving French paraphrases, abstracts or reproductions from memory of selected portions of the matter read; the study of a grammar of moderate completeness; writing from dictation. 1 unit.

SPANISH

ELEMENTARY SPANISH, A. Two years' preparation, covering the following ground:

1. Drill in correct production of Spanish sounds.

2. The rudiments of grammar, illustrated by abundant easy exercises.

3. The reading of about 150 pages of graduated texts with constant translating into Spanish of easy variations of sentences read, the teacher giving the English.

4. Aural Drill. Practice in translating into English of Spanish words, clauses and sentences heard but not seen, the teacher giving the Spanish.

During the second year:

1. Reading of 250 to 400 pages of easy modern prose.

2. Constant practice in translating into Spanish easy variations upon the texts read.

3. Aural practice and drill in pronunciation.

4. Mastery of the form and uses of pronouns, of the subjunctive mode and of the forms of the radical changing verbs.

2 units.

INTERMEDIATE SPANISH, B. The reading of not less than 500 additional pages of Spanish prose together with the translation of at least 40 pages of simple connected English prose into Spanish. 1 unit.

LATIN

The following requirements in Latin are in accordance with the recommendation made by the American Philological Association, October, 1909.

LATIN, A and B. First and Second Year Latin. Grammar, Elementary Prose Composition. Reading of an amount not less than Cæsar, *Gallic War*, I-IV, selected by the schools from Cæsar *Gallic War* and *Civil War*) and Nepos (*Lives*). 2 units.

LATIN, C. Third Year Latin. Reading of an amount not less than Cicero, *Orations against Catiline, For the Manilian Law*, and *For Archias*, selected by the schools from Cicero (*Orations, Letters* and *De Senectute*) and Sallust (*Catiline* and *Jugurthine War*). 1 unit.

LATIN, D. Fourth Year Latin. Reading of an amount not less than Vergil, *Aeneid*, I-VI, selected by the schools from Vergil (*Aeneid, Bucolics*, and *Georgics*) and Ovid (*Metamorphoses, Fasti, Tristia, Amores*). 1 unit.

GREEK

The following requirements in Greek are selected in as close accordance as is practicable with the recommendations of the American Philological Association.

GREEK. Grammar; Elementary Prose Composition, consisting principally of detached sentences to test the candidate's knowledge of grammatical construction; Xenophon: the first four books of the *Anabasis;* the translation, at sight, of a passage from some work of Xenophon. 2 units.

GREEK, Homer's *Iliad*, I-III: The first three books of the *Iliad* (omitting II, 494-end), and the Homeric forms, constructions and prosody. 1 unit.

CHEMISTRY

The requirement in Chemistry is based on the report of the Committee on Chemistry of the Science Department of the National Educational Association.

ELEMENTARY CHEMISTRY. It is recommended that the candidate's preparation in chemistry include: (a) individual laboratory work, comprising at least forty exercises; (b) instruction by lecture table demonstrations, to be used mainly as a basis for questioning upon the general principles involved in the pupil's laboratory investigations; (c) the study of at least one standard text book, to the end that the pupil may gain a comprehensive and connected view of the most important facts and laws of elementary chemistry. 1 unit.

Students, properly qualified, will be examined in Elementary Chemistry on the first Saturday of the term; those passing the examination will be privileged to omit Elementary Chemistry (390) and will, instead, take Chemistry (393) during the first term.

DRAWING

FREEHAND DRAWING. Sketching of simple geometrical figures, of objects, and from copy. At least twenty plates must be submitted. ½ unit.

MECHANICAL DRAWING. The use of instruments and the preparation of at least twenty plates, illustrating the elements of descriptive geometry or simple machine parts. ½ unit.

PHYSIOGRAPHY

PHYSIOGRAPHY. The study of a standard text-book in physical geography, that a knowledge may be gained of the essential principles, and of well-selected facts illustrating those principles. Individual laboratory work, comprising at least forty exercises with notebook, is recommended.

½ or 1 unit.

BOTANY

BOTANY. An amount equal to that contained in Bergen's *Foundations of Botany* with laboratory work. ½ or 1 unit.

PHYSIOLOGY AND HYGIENE

PHYSIOLOGY AND HYGIENE. A course covering approximately what is given in such a text-book as Huxley & Youman's *Physiology and Hygiene.* ½ or 1 unit.

ZOÖLOGY

ZOÖLOGY. The equivalent of Jordan, Kellogg & Heath's *Animal Studies* with laboratory work. ½ or 1 unit.

MANUAL TRAINING

MANUAL TRAINING. Shop work in wood or metal in schools giving courses in manual training. ½ or 1 unit.

BOOKKEEPING, TYPEWRITING AND STENOGRAPHY

BOOKKEEPING, TYPEWRITING AND STENOGRAPHY, covering a formal course of study at school. 1 or 2 units.

DATES OF EXAMINATIONS

Examinations for admission to the University are held in June and September in the following order:

First Day.—Geometry, 8 A.M.; Physics, Ancient History, 2 P.M.

Second Day.—Elementary Algebra, *A*, 8 A.M. to 10 A.M., Elementary Algebra, *B*, 10 A.M. to 12 M.; Trigonometry, 2 P.M.

Third Day.—Latin, 8 A.M.; German, French, Spanish, Greek, 2 P.M.

Fourth Day.—English, 8:30 A.M.; History, 2 P.M.

The dates for 1921 and 1922 are as follows: in 1921, Wednesday, Thursday, Friday and Saturday, June 15, 16, 17, and 18; and Friday, Saturday, Monday and Tuesday, September 16, 17, 19 and 20; in 1922, June 14, 15, 16 and 17, and September 15, 16, 18 and 19.

Examinations in subjects presented for elective units may be arranged for by correspondence with the Registrar.

Candidates for admission wishing to take examinations in any advanced subject for credit should notify the Registrar before September 1.

Certificates of the College Entrance Examination Board are accepted instead of the entrance examinations held at the University in those subjects in which the recorded grade is 60 per cent. or over.

ADMISSION TO ADVANCED STANDING

Candidates for admission to advanced studies in any course must, in addition to meeting entrance requirements, pass examinations in the work already done by the classes which they desire to enter. These examinations are held in September according to a fixed schedule, in the week preceding the opening of the University.

A student from another college or university is admitted without entrance examinations, provided he has covered the entrance subjects required at this University and has attended another college or university for one or more complete terms. Evidence to that effect should be filed with the Registrar. If a student has been dropped from another college or university, he must present his record to the Committee on Standing of Students and his admission will largely depend upon the record he made in the institution from which he was dropped.

Applicants who have obtained a certificate that the entrance requirements of the University are satisfied are advised to report personally to the Secretary of the Faculty. The Secretary of the Faculty will issue to the applicant a paper authorizing him to confer with the professors regarding the subjects for which he desires credit. It is necessary for an applicant to bring a certificate naming the subjects completed at another college, together with a copy of the catalogue or register of the college; and it is desirable for him to bring his drawings, field notes, computations and laboratory notebooks for inspection, and personal certificates from his teachers showing the grades attained at the college from which he comes. Professors may admit the student to advanced standing if satisfied with these evidences of proficiency, or they may require formal examinations in the subjects for which he desires credits.

Professors will note their conclusions on the paper furnished the applicant, and he will return it to the Secretary of the Faculty within the time specified on its face. If all the subjects are accepted the applicant will be admitted in full standing to the Freshman, Sophomore, or Junior Class, as the case may be. If nearly all are accepted, the candidate may be admitted with conditions, and the Secretary of the Faculty will inform him of the rules applicable to conditioned students.

Graduates of other colleges having the Bachelor's degree or its equivalent are similarly admitted to engineering courses. The length of time for the completion of a course will depend upon the student's attainments at entrance and his ability. Every opportunity will be given for the completion of a course in minimum time.

A student who anticipates taking a technical course at Lehigh University after graduation from college should so

arrange his work in college as to cover as many as possible of the subjects of the Freshman and Sophomore years of the technical course he intends to enter.

ADMISSION TO GRADUATE COURSES

Graduates of Lehigh University and others having satisfactory degrees conferred elsewhere may be admitted to advanced studies as outlined on page 135.

SCHOOL CERTIFICATES

Lehigh University has no permanent arrangement with any school whereby certificates are accepted instead of entrance examinations.

Applicants for admission on certificate should request their school principals to send to the Registrar as soon as the school closes in June a complete record of their work. Blanks for this purpose are supplied by the University.

Certificates are accepted in subjects in which records are satisfactory to the professors concerned and in which the work has been completed within reasonable time limits.

For admission to the College of Engineering records in mathematical subjects are accepted only if there is evidence of some satisfactory school study of mathematics completed not earlier than January of the entrance year.

For admission to the College of Arts and Science and to the College of Business Administration records in mathematical subjects are accepted only if there is evidence of some satisfactory school study of mathematics completed not earlier than June of the year preceding the entrance year.

For admission to the College of Engineering, to the College of Arts and Science and to the College of Business Administration records in the required foreign language are accepted only if there is evidence of some satisfactory school study of the language completed not earlier than January of the year preceding the entrance year.

EXAMINATIONS AT SCHOOLS

Upon the request of school principals the June entrance examinations may be held at schools on the regularly scheduled dates. Requests for examination papers should be sent to the Registrar before June 1.

THE COLLEGE OF ARTS AND SCIENCE

The College of Arts and Science of Lehigh University represents the traditional college course, modified to meet the needs of modern life and thought. Such a course is, in its purpose, primarily informing and cultural, not vocational; it seeks to gratify intellectual curiosity, to cultivate a love of learning, to impart the knowledge and discipline which are essential to intelligent and forceful living. It has besides certain specific uses: it is the customary approach to the professions of medicine, law, theology and teaching, and the usual basis for graduate study for higher degrees.

The entrance requirements are liberal, and such as may be met readily by graduates of Pennsylvania high schools of the first class. A statement of them may be found on page 17.

The plan of study comprises required subjects and unassigned or elective subjects. The required and elective subjects occupy respectively about two-thirds and one-third of the course. The required studies embrace courses in the English, German and French languages and literatures (two years each), mathematics, (trigonometry and solid geometry), chemistry (elementary chemistry and qualitative analysis), economics, history, psychology, biology, geology, and philosophy, subjects which may be regarded as fundamental to the nature and purpose of the course.

The studies of the Freshman year follow in general the subjects which have been presented for entrance. After the Freshman year the course becomes increasingly elective, a minimum of three hours weekly of electives being allowed in the Sophomore year, six in the Junior year and ten in the Senior year. An appointed member of the Faculty counsels students in the choice of their studies and keeps before them the importance of selecting their work according to a definite and consecutive plan. Students are dealt with individually rather than in groups, and the effort is made to suit the studies of each to his qualifications and purpose.

The minimum course of study comprises fifteen scholastic hours or periods weekly. Work is assigned on the assumption that two hours are required by the average student to prepare adequately for a recitation. Students of proved ability, how-

ever, are not limited to this minimum after the Freshman year, and even in that year an entering student may increase his course in chemistry from three to four hours, if, as in the case of those who are preparing for the study of medicine, there is good reason. In general, the College aims at a reasonable amount of work well done, rather than a large amount indifferently done.

Instruction is given by lectures, by recitations, by the assignments of readings and topics for study and dissertations, and, when the subject admits of it, by practical work in field or laboratory. Field work or laboratory work accompanies courses in geology, physics, chemistry, biology, psychology, and allied subjects; students in advanced mathematics use, in their study of astronomy, the telescope and other instruments of the Sayre Observatory. Practice in teaching is provided in the schools of the vicinity and in the Lehigh Evening School for those who expect to follow teaching. Students residing at Leonard Hall who are preparing, under the direction of the Bishop of the Episcopal Diocese of Bethlehem, for the theological seminary have opportunity for practical religious work.

In the following plan of study the unassigned hours are filled by subjects selected from the listed elective studies. These are not necessarily confined to the year to which in the lists they are assigned, but may be taken earlier or subsequently. But this privilege is limited by considerations of the roster and the principle that the course of each student shall be systematic and not haphazard.

Students who enter with full entrance requirements in Latin and Greek (four and three units) will ordinarily continue these studies during the Freshman year. A class in Beginners' Greek, open to Freshmen and Sophomores, is formed in alternate years. Students who begin Greek in College will ordinarily pursue the study of Greek for three years.

The degree of Bachelor of Arts (B.A.) is conferred upon graduates of the College of Arts and Science.

SCHEDULE OF STUDIES OF THE B.A. COURSE

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
English (3)	120, 121	English (3)	122, 125
Plane Trigonometry (3)	141	Solid Geometry (3)	140
German (3)	77 or 70	German (3)	77 or 71
or French (3)	98	or French (3)	99
Latin (3)	45	Latin (3)	46
or Ancient Lit. and History (3)	47	or Mediaeval Lit. and History	47
Greek (3)	55 or 64	Greek (3)	56 or 64
or Chemistry (2)	390	or Chemistry (3)	395
or Chemical Lab. (1)	392	Mil. Sci. & Tactics (2)	470
Mil. Sci. & Tactics (2)	470	Military Drill (½)	470
Military Drill (½)	470	Gymnasium (½)	500
Gymnasium (½)	500		

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
English Literature (2)	123	English Literature (2)	124
English Writing (1)		English Writing (1)	
Economics (3)	16	Economics (3)	17
Latin (3)	48	Latin (3)	49
or Greek (3)	57	or Greek (3)	58
or Physics (3)	327	or Physics (3)	327
German (3)	78 or 77	German (3)	79 or 77
or French (3)	100	or French (3)	101
Physical Education (½)	500	Physical Education (½)	500
Mil. Sci. & Tactics (2)	471	Mil. Sci. & Tactics (2)	471
Military Drill (½)	471	Military Drill (½)	471
Unassigned (3)+		Unassigned (3)+	

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Psychology (3)	1	Psychology (3)	1
French (3)	90 or 98	French (3)	90 or 99
or German (3)	70	or German (3)	71
Biology (3)	292	General Geology (2)	268
Physical Education (1)	500	Geological Lab. and Field Trips (1)	269
Unassigned (6)+		Physical Education (1)	500
		Unassigned (6)+	

SENIOR YEAR

FIRST TERM		SECOND TERM	
Philosophy (2)	7	Philosophy (2)	8
French (3)	97 or 100	French (3)	97 or 101
or German (3)	77	or German (3)	77
Physical Education (1)	500	Physical Education (1)	500
Unassigned (10)+		Unassigned (10)+	

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

ELECTIVE STUDIES

In order that elective subjects may be incorporated, so far as possible, in the University roster from term to term without conflicts, students are required to submit their electives to the Professor in charge of electives, for the first term on or before May 1, for the second term on or before December 15.

SOPHOMORE ELECTIVES

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Mod. European History (3)	41	Mod. European History (3)	41
Elementary Mechanics (3)	320	Elementary Mechanics and Heat (3)	321
Latin (3)	48	Latin (3)	49
Greek (3)	64 or 65	Greek (3)	64 or 65
Chemical Philosophy (3)	398	Advanced Chemistry (3)	399
Economic Geography (3)	35	Economic Geography (3)	35
Physiography (3)	277	Physiography (3)	278
French (3)	92	French (3)	92
or German (3)	70	or German (3)	71
History of Education (3)	10	Scientific Method (3)	19
		Physical Measurements (1)	322
		Spherical Trigonometry (1)	142

JUNIOR ELECTIVES

FIRST TERM		SECOND TERM	
U. S. History (3)	39	U. S. History (3)	39
Latin (3)	50 or 52	Latin (3)	51 or 53
Greek (3)	55, 59 or 61	Greek (3)	56, 60 or 62
French (3)	98, 100 or 102	French (3)	99, 101 or 102
or German (3)	79, 77 or 76	or German (3)	79, 78 or 76
Spanish (3)	110	Spanish (3)	110
Differential Calculus & Solid Analytic Geom. (4)	146	Integral Calculus (4)	147
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
Quantitative Analysis (4)	401	Quantitative Analysis (4)	403
Constitutional Law (3)	33	Constitutional Law (3)	33
English (3)	126	Comparative Anatomy (3)	293
Mineralogy (4)	266	English (3)	128
Education (3)	10 or 11	Education (3)	11
Italian (3)	116	Italian (3)	116
Economic Geography (3)	35	Economic Geography (3)	35
Business Law (2)	31	Business Law (2)	32
Labor Legislation (2)	23	Labor Legislation (2)	23
		Geological Lab. (2)	269

SENIOR ELECTIVES

FIRST TERM		SECOND TERM	
U. S. History (3)	40	U. S. History (3)	40
Latin (3)	50 or 52	Latin (3)	51 or 53
Greek (3)	57, 59 or 61	Greek (3)	58, 60 or 62
German (3)	80 or 81	German (3)	80 or 81
French (3)	100, 102, 103 or 104	French (3)	100, 102, 103 or 104
Italian (3)	117	Italian (3)	117
Spanish (3)	112	Spanish (3)	112
Organic Chemistry (5)	408	Organic Chemistry (5)	408, 409
Banking (3)	27	Banking (3)	27
Education (3)	11	Education (3)	11
Embryology (3)	294	Botany (2)	290
Bacteriology (2)	296	Physiology (2)	298
Mental Hygiene (2)	3	Advanced Bacteriology (2)	297
Finance (3)	18	Social Psychology (2)	4
International Law (3)	34	Finance (3)	19
English (3)	130 or 132	International Law (3)	34
Physics (3)	332	English (3)	131 or 134
Analytic Mechanics (2)	149	Physics (3)	332
Field Geology (3)	275	Astronomy (3)	150
Petrography (2)	276	Palaeontology (3)	272
Differential Equations (1)	148	Geology of N. A. (3)	273
Adv. Electricity & Magnetism (2)	328	Electrical Laboratory (1)	330
Electrical Laboratory (1)	329	Analytic Mechanics (3)	152

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

PREPARATION FOR ENGINEERING COURSES

If a student in the College of Arts and Science contemplates becoming a candidate for a degree in technology after completion of his B.A. course, he should choose as electives during the third and fourth years of his B.A. course such science studies as are contained in the first and second years of the technical course which he wishes afterwards to complete. By carefully selecting electives, with the advice and guidance of the head of his department and the professor in charge of the technical course concerned, the graduate of the B.A. course may enter the technical course chosen as a Junior in full standing, and obtain his technical degree in two years of further study.

PRE-MEDICAL COURSES

Certain medical schools require for entrance a full college course in addition to a high school course; others require a high school course yielding fourteen or more college entrance credits and at least two years in a college of liberal arts with

three-fourths of the study devoted to chemistry, physics and biology.

Corresponding to these two classes of entrance requirements the University offers the two appended plans of study, of which the second is designed for those who will spend but two years in college in preparation for the study of medicine, the first for those who will complete the college course and obtain their degree. Since the number of students which medical colleges of standing can accommodate is limited, practical considerations alone make advisable the fullest preparation one can command. It should also be remembered that no profession comes into closer touch with humanity than medicine, that to none is wide and accurate knowledge more essential, and that for its study no preparation can be too good.

SCHEDULE OF FOUR-YEAR PRE-MEDICAL COURES

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
English (3)	120, 121	English (3)	122, 125
Plane Trigonometry (3)	141	Solid Geometry (3)	140
German (3)	77 or 70	German (3)	77 or 71
or French (3)	98	or French (3)	99
Latin (3)	45	Latin (3)	46
or Ancient Lit. & History (3)	47	or Mediaeval Lit. & History (3)	47
Elementary Chemistry (2)	390	Qualitative Anal. (3)	395
Chemistry Lab. (2)	391	Stoichiometry (1)	397
Mil. Sci. & Tactics (2)	470	Mil. Sci. & Tactics (2)	470
Military Drill (½)	470	Military Drill (½)	470
Gymnasium (½)	500	Gymnasium (½)	500

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
English (3)	123, 129	English (3)	124, 133
German (3)	78 or 77	German (3)	79 or 77
or French (3)	100	or French (3)	101
Economics (3)	16	Economics (3)	17
Physics (3)	327	Physics (3)	327
Chemical Philosophy (3)	398	Advanced Chemistry (3)	399
Mil. Sci. & Tactics (2)	471	Mil. Sci. & Tactics (2)	471
Military Drill (½)	471	Military Drill (½)	471
Physical Education (½)	500	Physical Education (½)	500

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Psychology (3)	1	Psychology (3)	1
French (3)	90	French (3)	90
or German (3)	70	or German (3)	71
Biology (3)	292	Geology (3)	268, 269
Quantitative Anal. (4)	400, 402	Comparative Anatomy (3)	293
Theoretical Physics (2)	332	Botany (3)	290
Physical Education (1)	500	Physics (2)	332
		Physical Education (1)	500

SENIOR YEAR

FIRST TERM		SECOND TERM	
Philosophy (2)	7	Philosophy (2)	8
French (3)	97	French (3)	97
or German (3)	77	or German (3)	77
Organic Chemistry (5)	408, 409	Organic Chemistry (5)	410, 411
Embryology (3)	294	Physiology (2)	298
Bacteriology (2)	296	Psychology (3)	4, 6
Physical Education (1)	500	Physical Education (1)	500

SCHEDULE OF TWO-YEAR PRE-MEDICAL COURSE

FIRST YEAR

FIRST TERM		SECOND TERM	
English (3)	120, 121	English (3)	122, 125
German (3) or French (3)	77 or 70 98	German (3) or French (3)	77 or 71 99
Plane Trigonometry (3)	141	Solid Geometry (3)	140
Physics (3)	327	Physics (3)	327
Elementary Chemistry (2)	390	Qualitative Anal. (3)	395
Chemistry Lab. (2)	391	Stoichiometry (1)	397
Mil. Sci. & Tactics (2)	470	Mil. Sci. & Tactics (2)	470
Military Drill (½)	470	Military Drill (½)	470
Gymnasium (½)	500	Gymnasium (½)	500

SECOND YEAR

FIRST TERM		SECOND TERM	
English (3)	123, 129	English (3)	124, 133
German (3) or French (3)	78 or 77 100	German (3) or French (3)	79 or 77 101
Organic Chemistry (5)	408, 409	Comparative Anatomy (3)	293
Biology (3)	292	Botany (3)	290
Psychology (3)	1	Psychology (3)	4, 6
Physics (2)	332	Physics (2)	332
Mil. Sci. & Tactics (2)	471	Mil. Sci. & Tactics (2)	471
Military Drill (½)	471	Military Drill (½)	471
Physical Education (½)	500	Physical Education (½)	500

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

COURSES FOR TEACHERS

In the course leading to the degree of Bachelor of Arts, outlined on pages 31-35, the student may, through a selection of suitable electives, equip himself to teach in the high school the subject or subjects he has selected as his specialty, whether in the field of English, of ancient or modern language, of history, of biology and chemistry, of physics and mathematics, or of physiography and related subjects. In the course in Business Administration he is permitted to substitute, during the Junior and Senior years, courses in distinctly pedagogical subjects sufficient to make a total of fifteen term hours. He may thus equip himself to teach in secondary schools the important branches of commerce and industry.

No one may teach in the public schools of any state without first securing a license from that state. In Pennsylvania, as in most states, the special examination for such a license is waived in the case of college graduates, provided they have completed a certain number of hours in distinctly pedagogical studies, and have applied for a provisional college certificate to teach. At the end of three years of successful experience in teaching the State of Pennsylvania issues a permanent college certifi-

cate. The requirement in this State for a provisional certificate calls for 200 recitation hours in such studies as psychology, history of education, school management, methods of teaching, logic and ethics. The wish is general, however, among superintendents and principals that the graduate, when he begins to teach, shall have completed a much larger amount of distinctly pedagogical study than the law now demands, and that he shall have had some experience in observation and practice teaching.

Lehigh has endeavored to meet this wish. The University Department of Education has worked out a system of giving students opportunities in observation and practice teaching. Through the courtesy and liberal spirit of Boards of Education and Superintendents of Public Schools, through the University's close association with private schools, and through the work of the Lehigh Evening School, the system of practice teaching has been made in a measure adjustable to the needs of students with different aims and at different stages in their development of teaching power.

The course in Education at Lehigh may be outlined as follows:

FIRST TERM		SECOND TERM
SOPHOMORE YEAR		
History of Education (3)	10	Scientific Method (3) 9
FIRST TERM		SECOND TERM
JUNIOR YEAR		
General Psychology (3)	1	General Psychology (3) 1
Secondary Education (3)	11	Secondary Education (3) 11
FIRST TERM		SECOND TERM
SENIOR YEAR		
Special Method (3)	12	Special Method (3) 12

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

The courses in Psychological Problems, Social Psychology and History of Philosophy also throw considerable light upon the true purposes of education and the methods by which to secure them.

Graduates from state normal schools will, under the conditions prescribed by the State Department of Education, receive credit for equivalent studies in the field of education completed in the normal schools.

THE COLLEGE OF BUSINESS ADMINISTRATION

Requirements for admission to the College of Business Administration are given on page 18.

The aim of the Course in Business Administration is to provide a sound understanding of the structure, organization and functioning of industry, commerce and finance, and of the general causes and criteria of prosperity and depression. A study is made of the functions common to all business enterprises and of the general principles of administration. The student is shown the relation of the business executive to the various factors of business organization and control.

In addition to providing a broad training for business, this course gives opportunity to specialize in some one branch of business and to prepare for the study of law and for public service. The following groupings of subjects suggest the opportunities for specialized work:

PREPARATION FOR THE LAW

Advisers: Professor Stewart and Mr. MacGregor

Business Law
Constitutional Law
International Law
Economics
Accounting Theory and Practice
Corporation Accounting
Statistics
Finance
Banking and Currency
Investments
Labor Legislation and Administration
Transportation
Psychology

ACCOUNTANCY

Advisers: Professor Stewart and Associate Professor Bickley

Accounting Theory and Practice
Corporation Accounting
Auditing
Manufacturing Accounts
Economics
Business Law
Constitutional Law
Statistics
Finance
Banking and Currency
Investments
Industrial Management
Transportation

FINANCE, BANKING AND INVESTMENT BUSINESS

Advisers: Professor Stewart and Assistant Professor Curtis

Finance
Banking and Currency
Investments
Statistics
Economics
Accounting Theory and Practice
Corporation Accounting
Business Law
Transportation
Constitutional Law
Economic Geography
Industrial Management
Labor Legislation and Administration

INDUSTRIAL ADMINISTRATION

Advisers: Professor Stewart and Associate Professor Bickley

Accounting Theory and Practice
Corporation Accounting
Manufacturing Accounts
Economics
Industrial History
Economic Geography
Construction
Engineering Drawing
Psychology
Industrial Management
Labor Legislation and Administration
Business Law
Constitutional Law
Transportation
Statistics
Finance
Investments
Electives from Courses in Engineering and Chemistry

FOREIGN TRADE

Advisers: Professor Stewart and Assistant Professor Curtis

Economic Geography of the Western Hemisphere
Economic Geography of the Eastern Hemisphere
Economics
Spanish
Statistics
Business Law
International Law
Constitutional Law
Finance
Banking and Currency
Investments
Accounting Theory and Practice
Corporation Accounting

The work of the College covers four years. On its completion the degree of Bachelor of Science in Business Administration is given.

THE COURSE IN BUSINESS ADMINISTRATION

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
English (3)	120, 121	English (3)	122, 125
Spanish (3) or Portuguese (3)	110 or 111 114	Spanish (3) or Portuguese (3)	110 or 111 114
Industrial History (3)	38	Industrial History (3)	38
Plane Trigonometry (3)	141	Solid Geometry (3)	140
Engineering Drawing (3)	160a	Engineering Drawing (2)	161a
Construction (1)	162	Construction (1)	163
Mil. Sci. & Tactics (2)	470	Mil. Sci. & Tactics (2)	470
Military Drill (½)	470	Military Drill (½)	470
Gymnasium (½)	500	Gymnasium (½)	500

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Physiography (2)	277	Physiography (3)	278
Accounting (3)	20	Accounting (3)	21
Constitutional Law (3)	33	Constitutional Law (3)	33
Economics (3)	16	Economics (3)	17
Economic Geography of North and South America (3)	35	Economic Geography of North and South America (3)	35
Spanish (3) or Portuguese (3)	111 or 113 115	Spanish (3) or Portuguese (3)	111 or 113 115
Mil. Sci. & Tactics (2)	471	Mil. Sci. & Tactics (2)	471
Military Drill (½)	471	Military Drill (½)	471
Physical Education (½)	500	Physical Education (½)	500

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Business Law (2)	31	Business Law (3)	32
U. S. History (3)	40	U. S. History (3)	40
Labor Legis. & Adm. (3)	23	Labor Legis. & Adm. (3)	23
Transportation (2)	22	Transportation (2)	22
Statistics (3)	26	Corporation Finance (Elect.) (3)	18a
Corporation Accounting (Elect.) (3)	21	Statistics (3)	26
Corporation Finance (Elect.) (3)	18a	Economic Geography of the Eastern Hemisphere (3)	36
Economic Geography of the Eastern Hemisphere (3)	36	Psychology (2)	2
Psychology (2)	2	Physical Education (1)	500
Physical Education (1)	500		

SENIOR YEAR

FIRST TERM		SECOND TERM	
Finance (3)	19	Finance (3)	19
Banking and Currency (3)	27	Banking and Currency (3)	27
Investments (3)	25	Investments (3)	25
Auditing (Elect.) (3)	21a	Manufacturing Accounts (Elect.) (3)	21b
Mod. European History (3)	41	Mod. European History (3)	41
International Law (3)	34	International Law (3)	34
Development of Economic Thought (3)	24	Development of Economic Thought (3)	24
Physical Education (1)	500	Thesis	
		Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

Students may, with the approval of the Faculty, substitute for some of the subjects in the Junior and Senior years, other subjects which will better suit their future aims.

Prospective teachers should in this connection read the statement concerning Courses for Teachers.

THE COLLEGE OF ENGINEERING

THE COURSE IN CIVIL ENGINEERING

The requirements for admission to the Course in Civil Engineering are given on page 19.

The purpose of this course is to give a broad education in those general and scientific subjects which form the foundation of all branches of technology and special training in those subjects comprised under the term of Civil Engineering. The department aims to teach young men how to think and how to attack new problems, to impress upon them the underlying principles of engineering and to inspire them with a desire to do their best work.

The Freshman year is devoted mostly to fundamental studies which give both general culture and preparation for the technical work of the following years. Mathematics, physics, modern languages, military science and tactics and chemistry are given throughout both terms. Students continue in the Freshman year the modern foreign language accepted for entrance. Drawing is done throughout the year and the drawing room exercises are supplemented by recitations.

The course in Construction of the Freshman year affords students a general idea of the scope of engineering. In this course are grouped the topics of masonry, foundations of bridges and buildings, types of retaining walls and dams, the history of architecture and engineering, street and highway construction, the history of bridges and the materials of construction. The work covers two terms and is carried on by lectures.

Land and Topographic Surveying is given in the four weeks following the end of the Freshman year. By this arrangement the attention of students is concentrated upon a single subject, thus enabling practical field operations to be exemplified in the best manner. In Railroad Surveying of the Junior year both preliminary and final locations of a line are made and plans, profiles and estimates of cost are prepared. In Geodetic Surveying, given in the Senior year, triangulations of a high degree of precision are executed, also determinations of azimuth and adjustments of the results are made by standard methods. A large collection of levels, transits and other surveying in-

struments enables the students to become familiar with instruments of the best type.

Among other required subjects is Strength of Materials, which presents the theory of beams, columns and shafts, and the methods of computing and designing them. Laboratory tests are made of timber, brick, iron and steel. Strength of Materials as here presented may be described as applied mechanics, that is, the application of mechanics to the design of engineering structures. The testing of materials is of great importance for the student's understanding of the mechanics of engineering and for the capacity it gives him to manipulate apparatus and to handle machines.

Roofs and Bridges receive attention throughout four terms. The analysis of trusses by graphic methods is given in the second term of the Sophomore year. Analytical methods of computing stresses are taken up in Roofs and Bridges of the second term of the Junior year and in Bridge Design and Bridges and Dams of the Senior year. Visits are made to bridges and to bridge shops. In the Senior year designs and working drawings are prepared by each student for both a highway and a railroad bridge. Some of these drawings are made in the same manner as in drawing rooms of bridge companies and others are general, that is, design drawings only. The theory of cantilever, draw, suspension and arch structures receives detailed attention. The design and construction of reinforced concrete are given in the second term of the Senior year in the course in Reinforced Concrete. This extended training in bridge engineering furnishes a foundation for structural steel and reinforced concrete work in practice.

Hydraulic Engineering and Sanitary Engineering are treated at length. The theory of the flow of water through orifices, weirs, pipes and channels together with the principles of hydraulic motors is given in the Junior year, the work being supplemented by testing in the hydraulic laboratory. In the Senior year the subjects of water supply, water and sewerage are discussed. The methods of collecting, purifying and distributing water are explained and compared; house drainage, the design of sewerage systems and the disposal of sewage also receive attention. Computations for dams, standpipes, sewers and other appurtenances are made. Canal engineering,

river and harbor work and land drainage are studied; irrigation by both water and sewage are discussed. This training in Hydraulics and Sanitary Engineering subjects, including Sanitary Biology of the Senior year, is planned to enable a graduate to enter upon the work of city engineering. In connection with the course in hydraulics, measurements are made of the flow in the Lehigh River, the Lehigh Canal and other streams in the vicinity of Bethlehem and the data thus obtained are studied later and reports written thereon. In view of the increasing importance of water power development this work is of value and interest.

Contracts and Specifications of the second term of the Senior year is presented by the Civil Engineering Department more from the engineering than from the legal viewpoint. This course, consisting of two lectures a week, gives the essential features of contracts and the form and scope of contracts and specifications as used in building engineering works.

Ship Construction and Ocean Transportation, required of Seniors in Civil Engineering, includes a brief history of ship development and treats of steel design and construction, especially of the hull which is closely allied to structural design. Lectures are given concerning the planning of harbors and the design and construction of such terminal facilities as piers, dry docks and railroad facilities required at ocean terminals. Ocean trade routes, ship canals and their influence on trade routes, ocean freight rates and terminal charges are some of the phases of foreign commerce treated in this course.

A description of the Fritz Engineering Laboratory which is operated by the Civil Engineering Department is given in this Register under the heading of Buildings.

The student who completes this course receives the degree of Civil Engineer (C.E.). Mature young men, if properly qualified, may take special studies without being candidates for the degree. Graduates of this course may become candidates for the degree of Master of Science under the regulations stated elsewhere in this Register.

THE COURSE IN CIVIL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Qualitative Analysis (3)	395
Chemistry Lab. (2)	391	Stoichiometry (1)	397
Elementary Mechanics (3)	320	Elem. Mech. & Heat (3)	321
French (3)	94	Phys. Measurements (1)	322
or Spanish (3)	111	French (3)	94
or German (3)	75	or Spanish (3)	111
Engineering Drawing (3)	160	or German (3)	75
Construction (1)	162	Engineering Drawing (2)	161
Mil. Sci. & Tactics (2)	470	Construction (1)	163
Military Drill (½)	470	Mil. Sci. & Tactics (2)	470
Gymnasium (½)	500	Military Drill (½)	470
		Gymnasium (½)	500

SUMMER TERM: Land and Topographic Surveying (3), 164.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus & Solid Analytic Geom. (4)	146	Integral Calculus (4)	147
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
Mineralogy (4)	266	General Geology (2)	268
English (2)	123, 129	Geological Lab. and Field Trips (2)	269
Economics (2)	16	English (2)	124, 133
Stereotomy (3)	165	Astronomy (2)	150
Mil. Sci. & Tactics (2)	471	Graphic Statics (2)	166
Military Drill (½)	471	Mil. Sci. & Tactics (2)	471
Physical Education (½)	500	Military Drill (½)	471
		Physical Education (½)	500

SUMMER TERM: Shop Work or Engineering Construction (3).

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Strength of Materials (4)	167	Hydraulics (3)	171
Strength of Mat. Lab. (1)	168	Hydraulic Lab. (1)	172
Metallurgy (3)	247-249	Roofs & Bridges (3)	173
Heat Engines (3)	205	Heat Engines (3)	206
Analytic Mechanics (2)	149	Accounting (2)	20
Highway Engineering (2)	170	Railroad Surveying (4)	174
Dynamos and Motors (2)	354	Alternating Currents (2)	375
Dynamo Lab. (1)	355	Dynamo Lab. (1)	356
Physical Education (1)	500	Physical Education (1)	500

SUMMER TERM: Shop Work or Engineering Construction (3).

SENIOR YEAR

FIRST TERM		SECOND TERM	
Bridge Design (2)	175	Bridges & Dams (4)	181
Bridge Design Drawing (4)	176	Sanitary Engineering (3)	182
Hydraulic Engineering (4)	177	Reinforced Concrete (4)	183
Railroads (2)	178	Contracts & Specifications (2)	184
Geodetic Surveying (3)	179	Sanitary Biology (3)	295
or Prac. Astronomy (3)	151	Finance (2)	18
Mill Buildings (2)	180	English (2)	136
Business Law (2)	31	Physical Education (1)	500
Physical Education (1)	500		

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

THE COURSE IN MECHANICAL ENGINEERING

The requirements for admission to the Course in Mechanical Engineering are given on page 19.

The purpose of this course is to give young men a broad and thorough training in the fundamental subjects which underlie all engineering. The course is developed from the viewpoint that the engineer should be, first, a good, effective citizen, loyal and true to the community, and to the organization which he serves, and after that a professional man not only qualified to render service as an engineer of material, but equipped to cope with and carry forward the ethics of human engineering and leadership.

The Freshman year is given to fundamental studies in preparation for the technical work of the following years and to studies of general cultural value. The former comprise Advanced Algebra, Analytic Geometry, Elementary Chemistry with laboratory exercises, Qualitative Analysis, Stoichiometry, Elementary Mechanics, Heat, laboratory work in Physical Measurements and a course of lectures on Engineering Construction. The general studies are English, Military Science and Tactics, and modern languages,—French, German or Spanish. Students continue the language accepted for entrance.

At the close of the Freshman year a four weeks' course is given in Constructive Elements of Machinery and of Electrical Apparatus. Students may substitute two months of practical work in an industrial establishment if approved by the Department.

In the Sophomore year the following courses are given: Differential Calculus, Solid Analytic Geometry, Integral Calculus, Electricity and Magnetism, Light and Sound, Elementary Mechanics of Materials (Strength of Materials), Mechanical Drawing, Elementary Machine Design, and Steam Engines. The laboratory course covers mechanics, heat, light, electricity and magnetism. English and Military Science and Tactics are continued and courses in Economics and Accounting are given.

A second summer term at the end of the Sophomore year provides a four weeks' course in shop-instruction (Mechanical Technology). Upon approval by the Department, students may substitute two months of practical shop work in industrial establishments.

The courses given in the Junior year are Differential Equations, Analytic Mechanics, Strength of Materials, Machinery of Transmission, Graphic Statics of Mechanisms, Advanced Electricity and Magnetism, Mechanics of Machinery, Hydraulics, Kinematics, Metallurgy, Graphic Statics of Structures and Dynamos and Motors. Courses are given in Engineering Laboratory and Electrical Laboratory; laboratory courses also accompany the study of Strength of Materials and Hydraulics. In addition to the courses named, Business Law is given during the first term.

At the close of the Junior year students are required to spend at least eight weeks on student apprenticeship work, shop work, or engineering construction as approved by the Department. A report is required.

The courses of the Senior year are Technical Thermodynamics, Internal Combustion Engines (Gas Engines), Machine Design, Steam Turbines and a course designated by the general term Mechanical Engineering in which one or two of the following subjects are taken up: plant engineering, refrigeration, aeronautics, marine engines, etc. Along electrical lines the following courses are included: Alternating Currents, Electrical Engineering and Dynamo Laboratory. The work of the mechanical engineering laboratory is continued throughout the year. Courses are presented in Mill Buildings, Industrial Management, Contracts and Specifications, and Finance.

Instruction in Machine Design is given throughout the Sophomore year. There is a thorough drill in projection drawing. Freehand sketches are first made and measurements taken of machine pieces; these sketches are then converted into full-sized drawings. There is then considerable practise in the interpretation of such drawings. This is followed by difficult projections and intersections and exercises in the proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice. In their Senior year the students undertake the calculations, estimates and working drawings involved in the design of simple but complete machines, the general plan of arrangement being given in the form of rough

sketches, photographs or wood cuts. In the second term the Seniors make original designs for simple machinery.

After completing the general course in Physics, students in Mechanical Engineering take courses along electrical lines. The aim is a clear conception of electrical units and a working knowledge of resistance, impedance, reactance, capacity, the magnetism of iron and the magnetic circuit as used in the construction of electrical machinery. Attention is then directed to the theory and calculation of direct current dynamos, to the study of variable and alternating current phenomena and to the theory of the alternating current apparatus. Practical problems show their application. The laboratory work involves tests of resistance, insulation, consumption of energy and efficiency.

The course in Engineering Laboratory begins with the handling and calibration of the instruments and appliances belonging to the experimental side of mechanical engineering. The simpler tests and experiments are taken up next, and there is a gradual progress toward complex operations such as the complete test of a power plant or pumping station, or a full thermodynamic test of the steam engine. The course is, at present, most fully developed in the field of steam engineering, where it embraces steam calorimetry, flow of steam, the testing of steam traps and separators; of injectors, pumps, and the steam turbine; extensive practice with the indicator, engine tests of various sorts and boiler testing.

Due place is given in the course to gas engineering, tests of gas producers, gas engines and oil engines, work with compressed air, tests of hot-air engines, of centrifugal pumps and of various incidental appliances and apparatus. Dynamometer work includes experiments in friction and lubrication and determination of the efficiency of machines. The purpose of this course is to provide a system of well-selected and graded experiments which will illustrate and impress principles, develop the skill and judgment of the student and give training in the idea, method and detail of this sort of work.

In the Senior year one or two trips are made to New York or Philadelphia during which visits of inspection are made to power plants, municipal works, ship yards and a variety of industrial plants located in these cities or vicinity.

Graduates of this course receive the degree of Mechanical Engineer (M.E.).

THE COURSE IN MECHANICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Qualitative Analysis (3)	395
Chemistry Lab. (2)	391	Stoichiometry (1)	397
Elementary Mechanics (3)	320	Elem. Mech. & Heat (3)	321
French (3)	94	Phys. Measurements (1)	322
or German (3)	75	French (3)	94
or Spanish (3)	111	or German (3)	74
English (2)	120	or Spanish (3)	111
Construction (1)	162	English (2)	122
Mil. Sci. & Tactics (2)	470	Construction (1)	163
Military Drill (½)	470	Mil. Sci. & Tactics (2)	470
Gymnasium (½)	500	Military Drill (½)	470
		Gymnasium (½)	500

SUMMER TERM: Constructive Elements of Machinery and of Electrical Apparatus, 201, 350, or Practical Employment (3).

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus & Solid Analytic Geom. (4)	146	Integral Calculus (4)	147
Elec. & Magnetism (3)	323	Light and Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
Elem. Mech. Materials (1)	169	Steam Engines (4)	204
Drawing & El. Mach. Des. (3)	200	Elem. Machine Des. (3)	202
Boilers (1)	203	French (3)	95
French (3)	95	or German (3)	78
or German (3)	77	or Spanish (3)	113
or Spanish (3)	113	Mil. Sci. & Tactics (2)	471
Economics (2)	16	Military Drill (½)	471
Mil. Sci. & Tactics (2)	471	Physical Education (½)	500
Military Drill (½)	471	Accounting (2)	20
Physical Education (½)	500		

SUMMER TERM: Mechanical Technology, 208 or Practical Employment (3).

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Differential Equations (1)	148	Mech. of Machinery (2)	221
Analytic Mechanics (2)	149	Plant Engineering (1)	228
Strength of Materials (4)	167	Hydraulics (3)	171
Strength of Mat. Lab. (1)	168	Hydraulic Lab. (1)	172
Machinery of Trans. (3)	212	Metallurgy (3)	247-249
Graphic Statics of Mech. (2)	209	Kinematics (4)	215
Advanced Elec. & Mag. (2)	328	Graphic Statics (2)	166
Electrical Lab. (1)	329	Electrical Lab. (1)	330
Engineering Lab. (2)	210	Engineering Lab. (1)	211
Business Law (2)	31	Dynamos and Motors (2)	354
Physical Education (1)	500	Physical Education (1)	500

SUMMER TERM: Student Apprenticeship Work, Shop Work or Engineering Construction (3).

SENIOR YEAR

FIRST TERM		SECOND TERM	
Thermodynamics (4)	214	Steam Turbines (4)	224
Plant Engineering (1)	228	Mech. Engineering (3)	225
Gas Engines (3)	223	Plant Engineering (1)	227
Machine Design (4)	216	Machine Design (4)	220
Alternating Currents (2)	375	Electrical Engineering (2)	361
Dynamo Lab. (1)	355	Finance (2)	18
Engineering Lab. (1)	217	Dynamo Lab. (1)	356
Mill Buildings (2)	180a	Engineering Lab. (1)	222
Industrial Management (2)	24	Contracts & Specifications (2)	184
Physical Education (1)	500	Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

THE COURSE IN METALLURGY

The requirements for admission to the Course in Metallurgy are given on page 19.

This course is designed to prepare the student for practice in any or all directions in the field of metallurgy, such as the extraction of metals from their ores and the working and refining of metals. The two branches of this subject formerly comprised in the separate courses of Metallurgical Engineering and Electrometallurgy have been united, so that the graduate is properly equipped in both of these directions and may properly be designated as prepared in the whole field of metallurgy.

The basis of the course is necessarily fundamental and thorough training in mathematics, chemistry and physics, followed by such advanced chemistry as is useful to the metallurgist. These fundamental studies are not cut or restricted, but are given the full prominence which they should have in a metallurgist's education.

Collateral studies in other departments than metallurgy are liberally provided, such as Mineralogy, Blowpiping, General Geology, Geological Practice and Economic Geology in the Department of Geology; Mechanical Drawing and Ore Dressing in the Department of Mining Engineering; Advanced Electricity and Magnetism and Electrical Laboratory in the Department of Physics; Alternating Currents, Dynamos and Motors, Electric Power Transmission, Electrical Engineering and Dynamo Laboratory in the Department of Electrical Engineering; Elements of Construction of Machinery, Heat Engines, comprising the study of boilers, steam engines, gas engines and internal combustion motors, and Engineering Laboratory, in the Department of Mechanical Engineering; Hydraulics and Strength of Materials, with laboratory testing, in the Department of Civil Engineering.

Instruction in English composition, writing and oratory, in Economics, Business Law, and Contracts and Specifications is included in order to broaden the student's education. The study of German or French for one year is required, the student continuing the language on which he enters; if a student enters on Spanish he takes one year of German. The one year of German or French is supplemented in the Senior year by read-

ings in Metallurgical German or French with the staff of the Department of Metallurgy.

The studies in chemistry, which are so important to the metallurgist, include Laboratory Experiments, Qualitative and Quantitative Analysis, both gravimetric and volumetric, of the more common ores and metallurgical products, including Gas Analysis and Assaying, along with courses in Stoichiometry, Chemical Philosophy, Advanced Chemistry, Physical Chemistry and Physical Chemistry Laboratory. This instruction, together with the course in Physics and Physical Laboratory, constitutes the foundation on which the metallurgical instruction is based.

The special instruction in Metallurgy is begun by introductory courses of lectures on the history of the metals, their economic and mechanical importance, their physical and chemical properties, including statistics of their production and details of the distribution of their ores and the geographical distribution and conditions of their production. In connection with this some visits are taken to near-by metallurgical plants to make the student familiar with the appearance and general outline of metallurgical apparatus. Courses of lectures extending over a year take up in detail the principles of metallurgy in general. They begin with the general physical and chemical principles utilized in extracting metals from their ores, and the manner in which they are applied and are followed by a course of lectures on the Metallurgy of Iron and Steel, and by another course in the Metallurgy of the other metals, in which each metal is discussed in detail. In order to impress these principles upon the student and to render their application familiar, he is required to solve a series of problems dealing with practical details of the metallurgical processes in an exact and quantitative manner, the data being taken from practice and the results being intended to give an insight into the most fundamental metallurgical questions. A course of lectures follows this in the principles of electrochemistry, and their application in electrometallurgy, accompanied by laboratory investigations of these principles as well as the general principles of metallurgical processes, including methods of making physical and chemical measurements which are of value to the practicing metallurgist. A course in Metallography acquaints the student with the methods of studying with the microscope and other

instruments of precision, the physical properties, constitution and structure of metals and alloys. The course in Metallurgical Design covers the principles of designing metallurgical plant and apparatus, involving fixing the sizes and shapes of various parts of metallurgical apparatus. The seminary in the Senior year is intended to bring together the members of the Department and the students in the discussion of current metallurgical questions and problems, and students' theses.

In the summer vacations at the end of the Sophomore and Junior years the student is required, if arrangements can be made, to spend two months in practical work in a metallurgical establishment or such other plant as is approved by the Department.

The proximity of the works of the Bethlehem Steel Company and the kindness of its officers give opportunity for visits of inspection by the students in classes and individually, thus affording unusual facilities for the practical study of the metallurgy of iron and steel. In connection with the metallurgical laboratory work, it is the practice to make investigations of the working efficiencies of furnaces in actual operation. Occasional visits of inspection are made to more distant works, in connection with the metallurgy of zinc, copper, lead, gold and silver.

Graduates of this course receive the degree of Metallurgical Engineer (Met.E.).

THE COURSE IN METALLURGY

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Qualitative Analysis (3)	395
Chemistry Lab. (2)	391	Qual. Anal. Conf. (1)	396
Elementary Mechanics (3)	320	Stoichiometry (1)	397
German (3)	75 or 70	Elem. Mech. & Heat (3)	321
or French (3)	94	Phys. Measurements (1)	322
English (2)	120, 121	German (3)	75 or 71
Mechanical Drawing (3)	300	or French (3)	94
Mil. Sci. & Tactics (2)	470	English (2)	122, 125
Military Drill (½)	470	Descriptive Geometry (2)	300
Gymnasium (½)	500	Mil. Sci. & Tactics (2)	470
		Military Drill (½)	470
		Gymnasium (½)	500

SUMMER TERM: Constructive Elements of Machinery and of Electrical Apparatus (3), 201, 350.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. & Integral Calculus (4)	147
Quantitative Analysis (3)	401	Quantitative Analysis (3)	403
Quant. Anal. Conf. (1)	402	Quant. Anal. Conf. (1)	405
Chemical Philosophy (3)	398	Advanced Chemistry (3)	399
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
Introductory Met. (1)	242	Hydraulics (3)	171
Economics (2)	16	Introductory Met. (1)	242
Mil. Sci. & Tactics (2)	471	Mil. Sci. & Tactics (2)	471
Military Drill (½)	471	Military Drill (½)	471
Physical Education (½)	500	Physical Education (½)	500

SUMMER TERM: Assaying, 413, Practical Employment (3).

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Physical Chemistry (3)	419	General Metallurgy (2)	244
Physical Chem. Lab. (1)	420	Met. of Iron & Steel (2)	245
Mineralogy (4)	266	Met. Problems (1)	246
Blowpipe Analysis (1)	267	General Geology (2)	268
Ore Dressing & Lab. (3)	302	Geological Lab. and Field Trips (2)	269
Adv. Elec. and Mag. (2)	328	Alternating Currents (2)	375
Electrical Lab. (1)	329	Electrical Eng. (2)	361
Dynamos & Motors (2)	354	Electrical Lab. (1)	330
Heat Engines (3)	205	Dynamo Lab. (1)	355
Physical Education (1)	500	Heat Engines (3)	206
		Blowpipe Analysis (1)	267
		Physical Education (1)	500

SUMMER TERM: Practical Employment (3).

SENIOR YEAR

FIRST TERM		SECOND TERM	
Strength of Materials (4)	167	Electrometallurgy (1)	254
Strength of Mat. Lab. (1)	168	Metallurgical Design (2)	258
Non-ferrous Met. (4)	251	Metallurgical Lab. (2)	256
Met. Problems (1)	252	Met. Seminary (1)	260
Metallography (2)	257	Thesis (3)	261
Electrochemistry (1)	253	Engineering Lab. (1)	218
Electrochem. Lab. (1)	255	Elec. Power Transmission (3)	372
Engineering Lab. (1)	217	Economic Geology (4)	271
Electrical Lab. (1)	331	Contracts & Specifications (2)	184
Business Law (2)	31	Physical Education (1)	500
Met. French or Ger. (1)	259		
Seminary (1)	260		
Physical Education (1)	500		

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

THE COURSE IN MINING ENGINEERING

The requirements for admission to the Course of Mining Engineering are given on page 19.

The object of this course is primarily to train a student for practice in the field of mining engineering. It is designed to give him the thorough fundamental training of an engineer and a breath of education that will enable him readily to undertake work in the various lines of engineering frequently presented to one of his profession.

The course, therefore, places the graduate in the path of a large number of opportunities. Not only will he have had sufficient practice and training to enter upon the field of mining, but he can pursue work in which geology and metallurgy play an important part, and also in related engineering projects.

In the Freshman year a foundation is laid in the fundamental subjects of mathematics, physics, chemistry, English and modern foreign languages. The modern language pursued is the one presented for entrance. Lectures are given in physiology and hygiene, also in military science and tactics. Military drill and systematic physical exercise are required.

The course in Drawing begins as soon as the student enters the University. He learns the use of drawing instruments, makes tracings and blue prints, drawings of machine parts of simple construction, and solves problems in Descriptive Geometry. Lectures on Construction are given to show the general scope of engineering.

The summer schools in Land and Topographic Surveying and in Mine and Railroad Surveying are held at the close of the Freshman and Junior years respectively. The second of these schools is conducted partly in the mining regions; this gives practice in mine and railroad surveying and permits a study of mining operation and mining plants, from which data are secured exemplifying class room work and facilitating the course in Mining Design of the Senior year.

The courses in Chemistry extend from the first term of the Freshman year to the summer school in Assaying at the end of the Sophomore year. Beginning with an introduction to general chemical theory and the elements, supplemented by laboratory

work, the subject is continued by Qualitative and Quantitative Analysis. Chemical problems and reactions are taught in Stoichiometry. The instruction includes the analysis of common ores, fuels, gases and metallurgical products.

Courses in Business Law, Finance, Industrial Management, Contracts and Specifications, extending over the two upper years, present to the student the several economic, commercial, administrative and legal aspects of conditions existing in the industrial world which are of particular concern to the engineering profession.

The importance of the conservation of the timber resources of the country and the preservation of wood against decay are treated in Forestry, together with the characteristics of the woods of the important timber species. The course in Biology takes up the study of living organisms, their structure, development, origin and distribution.

Mineralogy is introduced by a short course in Crystallography, in which models of crystals and mineral specimens are studied. The various means of identification are then applied to more difficult minerals, the determination of which may be assisted and effected by the work in Blowpipe Analysis.

In the courses in Geology, the student studies the forms and structures of the rock masses of the earth's crust, and the forces which modify them. A brief review of historical geology deals with the fossil life of the globe. Practice in Field Geology teaches the methods by which rock formations are accurately mapped. Economic Geology treats of the origin, mode of occurrence and distribution of the metallic and nonmetallic minerals and substances of commercial value in the earth. The course in Petrography enables the student to identify the common rock-forming minerals by the use of the microscope, especially when the constituents are too fine-grained to be determined by the eye alone. Practice in the petrographic and geological laboratory and in the field qualifies the student to recognize the main types of rocks.

Physiography treats of the classification of land forms and their geographical distribution, their relation to geologic structure, weather and climate, and their influence upon the economic development of countries. The course in Geology of North America discusses the geologic ages and the geographic

distribution of the rocks of the continent, their structure and history, and includes studies of the great surveys that have been made. Paleontology reviews the life of past ages and involves the study and identification of fossils as a means of determining the age of rocks by the principles of stratigraphy.

The course in Heat Engines includes a practical study of boilers, steam and gas engines and steam turbines; work in the Wilbur Engineering Laboratory includes tests and calculations of efficiencies and powers under varying conditions.

Strength of Materials treats of the theories which govern the strength of all kinds of common materials used in construction. Practice is given in computing and designing beams, columns, girders, etc. Hydraulics deals with the flow of liquids through orifices, mains, pipes and channels, and with the principles of hydraulic motors; practical work in the Fritz Engineering Laboratory is a part of this course. Graphic Statics qualifies the student to compute the forces developed in roof trusses, beams and girders by the methods of graphical analysis.

The instruction in Mining Engineering is given during the Junior and Senior years, under the following subdivisions: prospecting, boring, mining or exploitation, haulage, hoisting, drainage, ventilation, lighting, first-aid, railroads, construction materials and mine administration. These subjects treat successively of the steps by which minerals are discovered and valued, the manner in which they are extracted from the earth and brought to the surface, the means by which mines are maintained in an economical condition from the viewpoint of mine owner and miner, the manner in which accidents may occur and means for guarding against them, and the treatment of injured persons.

The subject of Ore Dressing, supplemented by work in the Coxe Mining Laboratory, deals with the processes by which ores and fuels, direct from the mine, are rendered marketable. Construction Materials treats of the materials used in roads and structures in and around mines. Mine Administration discusses the method of employing labor and of keeping accounts, mining principles and management.

The course in Oil and Gas Technology includes a study of the occurrence and distribution of petroleum and natural gas, the

methods of prospecting, the means for obtaining them from the earth, and their storage and transportation.

In Mining Design the student employs principles studied and observations made as the basis for designs and working drawings of parts of mining plant to fulfill given conditions.

In Metallurgy the general principles of the subject embracing fuels, furnaces and processes, are presented, followed by the metallurgy of iron and steel, copper, lead, gold, silver, zinc, tin, mercury, nickel and aluminium. Electrometallurgy familiarizes the student with the practical applications of electricity to metallurgical processes including electric-furnace practice.

Dynamos and Motors and Alternating Currents extend over the entire Senior year and embrace the study of the industrial applications of electricity which are of particular value to the mining engineer; practical work in the Dynamo Laboratory is included in these courses.

It may thus be observed that the student of the Course in Mining Engineering has studies in all of the technical departments of the University, as well as in many of the arts and science departments.

The facilities for exemplifying the work of the course are exceptional. Cement mills, cement, slate and other quarries, ore and coal mines are within easy distance, and in the city are the great works of the Bethlehem Steel Company. During the Junior and Senior years all students in Mining Engineering are required to make inspection trips to the anthracite coal regions and to the metal mining districts of eastern Pennsylvania and of New Jersey and to the metallurgical works of those districts.

The Department of Mining Engineering has exceptional facilities in the Eckley B. Coxe Mining Laboratory. A description of the Laboratory is given on pages 155-156 of this Register.

Graduates of this course receive the degree of Engineer of Mines (E.M.).

THE COURSE IN MINING ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Qualitative Analysis (3)	395
Chemistry Lab. (2)	391	Stoichiometry (1)	397
Elementary Mechanics (3)	320	Elem. Mech. & Heat (3)	321
Spanish (3)	111	Phys. Measurements (1)	322
or French (3)	94	Spanish (3)	111
or German (3)	75	or French (3)	94
English (2)	120	or German (3)	75
Mechanical Drawing (2)	300	English (2)	122
Construction (1)	162	Construction (1)	162
Mil. Sci. & Tactics (2)	470	Descriptive Geom. (2)	300
Military Drill (½)	470	Mil. Sci. & Tactics (2)	470
Gymnasium (½)	500	Military Drill (½)	470
		Gymnasium (½)	500

SUMMER TERM: Land and Topographic Surveying (3), 164.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus & Solid Analytic Geom. (4)	146	Integral Calculus (4)	147
Quantitative Analysis (3)	401	Quantitative Analysis (3)	403
Quant. Anal. Conf. (1)	402	Quant. Anal. Conf. (1)	405
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
Mineralogy (4)	266	General Geology (2)	268
Blowpipe Analysis (1)	267	Geol. Lab. & Field Trips (3)	269
Economics (2)	16	Blowpipe Analysis (1)	267
Mil. Sci. & Tactics (2)	471	Mil. Sci. & Tactics (2)	471
Military Drill (½)	471	Military Drill (½)	471
Physical Education (½)	500	Physical Education (½)	500

SUMMER TERM: Assaying (3), 413.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Mining (4)	301	Mining (4)	303
Ore Dressing & Lab. (3)	302	General Metallurgy (2)	244
Strength of Materials (4)	167	Met. of Iron & Steel (2)	245
Heat Engines (3)	205	Met. Problems (1)	246
Petrography (2)	276	Heat Engines (3)	206
Graphic Statics (2)	166	Hydraulics (3)	171
Business Law (2)	31	Hydraulic Lab. (1)	172
Physical Education (1)	500	Physiography (2)	274
		Finance (2)	18
		Physical Education (1)	500

SUMMER TERM: Mine and Railroad Surveying (3), 304.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Mining (3)	305	Mining Design (3)	307
Economic Geology (2)	270	Economic Geology (4)	271
Non-ferrous Met. (3)	251	Electrometallurgy (1)	254
Dynamos & Motors (2)	354	Alternating Currents (2)	375
Dynamo Lab. (1)	355	Dynamo Lab. (1)	356
Field Geology (3)	275	Geology of N. America (3)	273
Forestry (3)	291	or Paleontology (3)	272
or Biology (3)	292	Oil & Gas Tech. (2)	306
Industrial Management (2)	24	Contracts & Specifications (2)	184
Engineering Lab. (1)	218	Engineering Lab. (1)	219
Physical Education (1)	500	Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

THE COURSE IN ELECTRICAL ENGINEERING

The requirements for admission to the Course in Electrical Engineering are given on page 19.

The object of this course is to give a broad education in those general and scientific subjects which underlie all the branches of engineering, and to give special training in those technical and business subjects which experience shows are most essential in the equipment of the electrical engineer. In seeking to accomplish this object the Department puts chief emphasis upon mastery of principles and thoroughness in the analysis of problems.

The course includes a number of special studies in civil, mechanical and metallurgical engineering, so that the graduate in Electrical Engineering is prepared not only to enter any of the branches of electrical engineering but also to deal with related problems in the other branches of engineering. The electrical engineering graduate of today finds that professional advancement often lies through commercial, managerial or executive channels. As superintendent or manager of electric light, power or railway properties he must be prepared to handle problems involving not merely material and technical details but human relations, touching workmen, capitalists, public utility commissioners, and the public. He must know something of the principles of accounting, economics, business law and industrial management. A number of such studies have been introduced into the course.

The fundamental studies are given in the early part of the course and include mathematics, physics, chemistry, English and that modern language accepted for entrance. These subjects include the more essential features of a broad education and they furnish a preparation for the more advanced scientific and technical training to follow. At the very outset the student, through the subject Construction, imbibes the spirit of engineering. He is taught its history, development, methods and scope.

Work in applied electricity, begun during the summer term at the end of the Freshman year, is continued through the Sophomore year in the study of Electric Distribution, and

Dynamos and Motors, with Dynamo Laboratory. The Junior and Senior years are devoted almost exclusively to advanced technical work.

The study of Electricity and Magnetism constitutes an introduction to the industrial applications of electricity. Electric Distribution makes immediate application of electrical theory to the calculation of lighting and power circuits, the testing of insulation resistance and similar problems. The study also includes the installation and wiring of electrical machinery, systems of electrical distribution, outside and interior wiring.

The study of Dynamos and Motors includes the construction, operation and control of direct current generators and motors, with numerous illustrative problems. The study of dynamo electric machinery is resumed during the Senior year in connection with the subjects Electrical Design and Alternating Current Machinery.

Fundamental subjects in mechanical engineering are required in this course. Machine Design is given throughout the Sophomore year. Constructive Elements of Machinery is given in the summer term at the end of the Freshman year in conjunction with the work in Constructive Elements of Electrical Apparatus. Mechanical Technology is given in the summer term at the end of the Sophomore year. Frequent visits of inspection are made to manufacturing establishments in the vicinity. Upon approval by the Head of the Department, students in Electrical Engineering will be permitted to substitute summer work in electrical shops or construction for either or both of the required summer schools. Following the work in Mechanical Technology comes the study of Graphic Statics of Mechanisms. It deals with graphic methods of determining the forces acting at all points of a machine and with the efficiency of mechanisms. Heat Engines includes the study of steam boilers, thermodynamics, steam engines and turbines, and gas engines. Engineering Laboratory is given throughout the Senior year.

Important studies in Civil Engineering are included in this course. Strength of Materials is concerned with the theory of beams, columns and shafts, and the method of computing and designing them; the subject includes practical work in the testing laboratory. Hydraulics, including laboratory practice,

treats of hydrostatics and theoretical hydraulics, the flow of water through orifices, weirs, pipes and channels, naval hydromechanics and hydraulic motors.

The study of General Metallurgy, Metallurgy of Iron and Steel and Metallurgical Problems is given during the second term of the Junior year. Lectures on Electrochemistry and Electrometallurgy are given during the Senior year.

Advanced studies in Electrical Engineering follow Electric Distribution, Dynamos and Motors, and Electricity and Magnetism of the Sophomore year. Advanced Theory of Electricity and Magnetism is devoted to the theory of electrical units and measurements, ferromagnetism, electromagnetism, and advanced theory of electrostatics and electric oscillations and waves, electron theory and electrolysis. The accompanying laboratory work is devoted to precise electrical measurements and the standardization and calibration of electrical measuring instruments. The Theory of Alternating Currents deals with the problems and methods of measurements which are peculiar to the modern practical applications of alternating currents and with the theory underlying the action of the important types of alternating current machinery and transmission lines. Alternating Current Machinery includes the study of the construction and operation of alternating current generators, motors, transformers and other apparatus.

The subject of Electrical Engineering deals with the application of physical principles to the solution of problems relating to direct and alternating current circuits and apparatus.

Dynamo laboratory work, beginning in the second term of the Sophomore year, is continued for five terms. Instruction is based on a laboratory manual or notes supplemented by individual direction and supervision in the laboratory. The students work individually or in pairs, and make the more important tests on direct and alternating current generators and motors, rotary converters, transformers and other electrical apparatus. Written reports of all tests made, with curves plotted from the observations and discussion of results, are required.

Electrical Design, begun in the first term of the Senior year, is pursued throughout the year. It includes the application of electric, magnetic and mechanical principles to the design of

various types of electrical apparatus. The instruction is given by recitations, problems and drafting.

Electrical Engineering Seminary continues throughout the Senior year. The work consists of the presentation before the class of papers on assigned topics, supplementing the regular work of the class-room and of reports on thesis work. The Department reading-room is well supplied with the leading electrical periodicals, American and foreign. One of the principal objects of the Seminary work is to encourage the systematic reading of the current engineering journals.

Dynamo Testing, given by lectures and problems, treats of standard and special methods of making tests on dynamo machines, transformers and other electrical apparatus.

Electric Stations takes up the location, design and equipment of stations, the selection of suitable prime movers, generators, switchboards and other apparatus. The use and operation of storage batteries, boosters and other auxiliaries receive consideration. Under Electric Traction are studied the construction, equipment and operation of different types of electric railways. The recent developments in the application of electric motive power to steam railroad conditions are discussed and the results of tests are analyzed.

The subject of Electric Power Transmission deals with the various elements constituting a transmission system. It includes a study of the generating plant, the transmission line and the receiving systems. Special attention is given to the design, construction and protection of the line. Under the last three subjects are included visits of inspection to electric light and power stations and manufacturing establishments in Bethlehem and elsewhere. Central station tests are made and reports are required.

Graduates of this course receive the degree of Electrical Engineer (E.E.).

THE COURSE IN ELECTRICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Qualitative Analysis (3)	395
Chemistry Lab. (2)	391	Stoichiometry (1)	397
Elementary Mechanics (3)	320	Elem. Mech. & Heat (3)	321
French (3)	94	Phys. Measurements (1)	322
or German (3)	75	French (3)	94
or Spanish (3)	111	or German (3)	75
English (2)	120, 121	or Spanish (3)	111
Construction (1)	162	English (2)	122, 125
Mil. Sci. & Tactics (2)	470	Construction (1)	163
Military Drill (½)	470	Mil. Sci. & Tactics (2)	470
Gymnasium (½)	500	Military Drill (½)	470
		Gymnasium (½)	500

SUMMER TERM: Constructive Elements of Machinery and of Electrical Apparatus, 201, 350, or Electrical Shops (3).

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus & Solid Analytic Geom. (4)	146	Integral Calculus (4)	147
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
Elem. Mech. Materials (1)	169	Dynamos and Motors (3)	352
Elec. Distribution (2)	351	Dynamo Lab. (1)	353
Drawing & El. Mach. Des. (3)	200	Machine Design (3)	202
English (2)	123, 129	Accounting (2)	20
Economics (2)	16	Mil. Sci. & Tactics (2)	471
Mil. Sci. & Tactics (2)	471	Military Drill (½)	471
Military Drill (½)	471	Physical Education (½)	500
Physical Education (½)	500		

SUMMER TERM: Mechanical Technology, 207 or Electrical Shops (3).

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Advanced Elec. & Mag. (2)	328	Alternating Currents (2)	359
Analytic Mechanics (2)	149	Electrical Engineering (2)	360
Differential Equations (1)	148	Dynamo Testing (1)	364
Theory of Alt. Cur. (3)	357	Dynamo Lab. (1)	362
Dynamo Lab. (1)	358	Electrical Lab. (1)	330
Electrical Lab. (1)	329	Heat Engines (3)	206
Heat Engines (3)	205	Hydraulics (3)	171
Strength of Materials (4)	167	Hydraulic Lab. (1)	172
Strength of Mat. Lab. (1)	168	Finance (2)	18
Business Law (2)	31	Metallurgy (3)	247-249
Physical Education (1)	500	Physical Education (1)	500

SUMMER TERM: Electrical Engineering Inspection, 376; Electrical Shops (3).

SENIOR YEAR

FIRST TERM		SECOND TERM	
Alt. Current Machinery (4)	363	Electric Traction (3)	371
Dynamo Lab. (3)	366	Dynamo Lab. (2)	374
Dynamo Testing (1)	365	Elec. Power Trans. (3)	372
Electrical Design (3)	367	Electrical Design (2)	370
Electrical Seminary (1)	369	Electrical Seminary (1)	373
Electric Stations (2)	368	Electrometallurgy (1)	254
Electrochemistry (1)	253	Engineering Lab. (1)	218
Engineering Lab. (1)	217	Contracts & Specifications (2)	184
Industrial Management (2)	24	Thesis (3)	377
Physical Education (1)	500	or Elec. Communication (3)	378
		Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

THE COURSE IN CHEMISTRY

The requirements for admission to the Course in Chemistry are given on page 19.

This course, leading to the degree of Bachelor of Science in Chemistry, offers an education primarily in chemistry, with some training in related sciences. The modern conception of an education in chemistry includes a simultaneous, thorough study of physics and mathematics. In addition to these so-called physical sciences, other studies, planned to develop and aid the thought-processes and culture of the student, are embodied in the course. Aside from preparation for the life of a professional chemist, it is well adapted for teachers of chemistry and as a course preliminary to the study of medicine.

This course and the Course in Chemical Engineering are both given under the direction of the Department of Chemistry, and facility is offered for changing from either course to the other at the end of either term of the Freshman year. The entrance subjects required are the same in both courses (see page 19), and the tuition and laboratory costs are practically the same. Subjects with the same title in the tabulated curricula (see pages 66 and 71) are given to students in both courses simultaneously and under the same teachers, and are equal in content. Details of chemistry subjects are described in the course in Chemical Engineering.

French and German receive considerably more attention in the course in Chemistry, both as language tools for the working chemist and in their cultural aspects. Students who enter the University on French continue French through the Freshman year, and take up German through the Sophomore and Junior years. Those who offer German as an entrance subject continue German through the Freshman and Sophomore years and study French through the Junior year. Students who offer Spanish for entrance take German through the Freshman and Sophomore years, and French through the Junior year.

Biology is placed in the Senior year and is taught in the Biology Department of the University. Its value in establishing clear ideas of plant and animal organisms, their functions and interrelations, is of importance to the scientist in chem-

istry; and, furthermore, the laws and theories of biology are of great moment in current intellectual and civic life. This subject is presented in lectures supplemented by work in the laboratory on higher and lower organisms. The course in Bacteriology of the Senior year is given in the same department.

Mineralogy, in the first term of the Junior year, develops the physical and chemical characteristics of minerals, and their recognition in specimens. The study of crystallography is included. Geology follows in the second term of this year.

Economics throughout the Junior year and Modern European History through the Senior year are given by the Department of History and Economics. The same department supervises the Summer Reading in Economics, embracing such subjects as origins of industry and their relations to science, the economic import of inventions, industrial management, business law and custom and contracts. The topics for Summer Reading are also correlated in the lectures under the heading Economics, mentioned above. It is believed that this course of reading and study under expert guidance will inculcate an appreciation of the profit and pleasure to be derived from a continued interest in history and economics.

In order to acquaint the student with factory methods and personnel, a required summer term of work in factory or laboratory is set for the vacations following the Freshman and Junior years. Young men of exceptional ability and ambition are encouraged to enroll in subjects given in the University not listed in the Course in Chemistry, subject to Faculty rules.

The foregoing course will serve as an excellent preparation for graduate study; students who desire to go forward to the Master's Degree (M.S.) will find information on page 135 of this Register.

THE COURSE IN CHEMISTRY

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Chemistry (1)	394
Chemistry Lab. (2)	391	Qualitative Analysis (3)	395
Elementary Mechanics (3)	320	Qual. Anal. Conf. (1)	396
Dr. & El. Mach. Des. (3)	200	Stoichiometry (1)	397
French (3)	94	Elem. Mech. & Heat (3)	321
or German (3)	76 or 72	Phys. Measurements (1)	322
English (2)	120	French (3)	94
Mil. Sci. & Tactics (2)	470	or German (3)	76 or 72
Military Drill (½)	470	English (2)	122
Gymnasium (½)	500	Mil. Sci. & Tactics (2)	470
		Military Drill (½)	470
		Gymnasium (½)	500

SUMMER TERM: Work in Industrial Shop or Laboratory (3). Summer Reading in Economics (1), 30.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus & Solid Analytic Geom. (4)	146	Integral Calculus (4)	147
Chemical Philosophy (3)	398	Advanced Chemistry (3)	399
Quantitative Analysis (3)	400	Quantitative Analysis (3)	404
Quant. Anal. Conf. (1)	402	Quant. Anal. Conf. (2)	405
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
German (3)	78 or 76 or 72	German (3)	79 or 76 or 72
English (2)	123	Mil. Sci. & Tactics (2)	471
Mil. Sci. & Tactics (2)	471	Military Drill (½)	471
Military Drill (½)	471	Physical Education (½)	500
Physical Education (½)	500		

SUMMER TERM: Assaying (3), 413. Summer Reading in Economics (1), 30.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Quantitative Analysis (2)	406	Organic Chemistry (4)	410
Quant. Anal. Conf. (2)	407	Organic Chem. Lab. (4)	411
Organic Chemistry (3)	408	General Metallurgy (2)	244
Organic Chem. Lab. (2)	409	Met. of Iron & Steel (2)	245
Mineralogy (4)	266	Met. Problems (1)	246
Economics (3)	16	General Geology (2)	268
French (3)	90	Economics (3)	17
or German (3)	75	French (3)	90
Physical Education (1)	500	or German (3)	75
		Physical Education (1)	500

SUMMER TERMS Work in Industrial Shop or Laboratory (3). Summer Reading in Economics (1), 30.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Physical Chemistry (3)	419	Physical Chemistry (2)	421
Physical Chem. Lab. (1)	420	Physical Chem. Lab. (1)	422
Industrial Chem. Lab. (3)	412	Research Chem. Lab. (2)	423
Non-ferrous Met. (4)	251	Industrial Analysis (3)	416
Met. Problems (1)	252	Industrial Anal. Conf. (1)	417
Biology (3)	292	Sanitary Chem. Lab. (2)	418
Bacteriology (2)	296	History of Chemistry (1)	424
History (3)	41	History (3)	41
Physical Education (1)	500	English (2)	136
		Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

THE COURSE IN CHEMICAL ENGINEERING

The requirements for admission to the Course in Chemical Engineering are given on page 19.

This course of study is designed to prepare the student for the profession of chemical engineering in the construction, control and management of manufacturing establishments which utilize principles of chemistry and its allied arts. Aside from the primary requirement of chemistry, the modern development of the chemical engineer enforces a thorough knowledge of physics and mathematics, together with sound understanding of such fundamentals in mechanical and electrical engineering as will make him a discriminating research and operating engineer.

Elementary Chemistry, begun in the Freshman year, in lectures with demonstrations, text-books and recitations, is supplemented by experiments in the laboratory which develop manipulative skill and make careful observation habitual. An alternate course, less elementary in both class-room and laboratory, is given to entering students who have had a considerable training in elementary chemistry. (See page 27.)

After this preliminary view of the elements of chemistry, there is developed that deeper insight into the changes of matter which is the particular province of general chemistry. In Chemical Philosophy of the Sophomore year particular attention is paid to the theories and modern concepts of chemistry, including solution, equilibrium and energy relations of molecules and of atoms, radio-activity, etc.,—a kind of junior physical-chemistry of the greatest, everyday importance in chemical engineering. This study is continued as Advanced Chemistry, covering a moderately advanced study of chemical substances, their preparation and properties, together with elementary consideration of phase rule and of such general applications as the relations underlying desirable properties in alloys, iron and steel, etc.

Organic Chemistry, taught during the entire Junior year, familiarizes the student with the simpler compounds of carbon, and acquaints him with the usefulness of this branch of chemistry in science, in the chemistry of animal and plant life, and in the manufacture of such chemical products as dyes, drugs and medicines, oils, fats, waxes, and many others.

Introduction to the chemical analysis of substances is begun through Qualitative Analysis in the second term of the Freshman year. This is a laboratory course, proceeding from the recognition of individual substances to the analysis of more complex solutions and solids. Lectures and recitations elucidate the facts and theories underlying analytical chemistry. The simpler mathematical relations of chemical processes are reviewed under Stoichiometry and are illustrated through many problems solved by the student. Quantitative Chemical Analysis by gravimetric, volumetric and electrolytic methods follows through the Sophomore year and the first term of the Junior year, and takes up the analysis of ores, fuels, metallurgical products, commercial chemicals and by-products. Frequent class-room conferences accompany the laboratory work and educate the calculations involved and the scientific foundations of quantitative analysis. The analysis of industrial organic substances and of food-stuffs, drinking and boiler waters is placed in the final term of the Senior year, when the student has a better foundation in increasing experience and a broader outlook toward the important significance of Industrial Chemistry. At this stage, too, is placed the sampling and analysis of illuminating and heating gas, flue gases and other special gases.

Fire-assaying of ores and of gold and silver bullion is taught in the summer term after the Sophomore year when continuous attention throughout the day can be given to muffles and furnaces. The practice in Assaying is accompanied by extensive consideration of the calculations and theories involved in the production of mixtures favorable for the work in hand. A course in Industrial Mineralogy is a part of this summer work, and leads to familiarity with about seventy-five minerals of commercial importance. These minerals are studied in their crystalline forms, also in the forms in which they often present themselves for final utilization by the chemical engineer.

The laboratory methods of Physical Chemistry and the systematic, deeper study of generalizations of chemistry learned in the Sophomore year are reserved for the Senior year under Physical Chemistry. Interrelations of the fundamentals of matter and energy are developed under such cognate headings as two-phase and multiphase systems, thermodynamics, gas reactions, mass action, electrochemistry, colloid chemistry, etc. Attention is given to the usefulness of Physical Chemistry

in the solution of manufacturing problems in Chemical Engineering.

Intensive instruction in the application of factory methods in Chemical Engineering is likewise placed in the Senior year and is grouped under Industrial Chemical Laboratory and Industrial Chemistry. The processes reviewed are varied; such as transportation of gases, liquids and solids; grinding, pulverizing; mechanical, hydraulic and pneumatic separation; evaporation; distillation; filter pressing; centrifuging; autoclaving. Characteristics and adaptability of engineering materials used in apparatus and machines receive full discussion. Selected industries are investigated and explained. Familiarity with manufacture in its scientific and economic aspects is promoted in the special laboratory fitted with industrial apparatus, the student finally submitting full working specifications for a plant designed for the preparation of some industrial product, together with estimates of cost of raw materials and cost of conversion into finished product. Lehigh University is fortunately situated in a district abounding in business enterprises which involve chemical engineering and visits are made to these plants and to factories in the nearby cities of Philadelphia and New York.

In Research Chemical Laboratory of the last term in the Senior year every student is required to solve a novel problem having a scientific basis and is expected to demonstrate some ability as an independent research worker. A short course in History of Chemistry, with individual reading of significant records, co-ordinates the past progress of the science and leads to a nobler pride and an enhanced initiative in the profession which the graduate enters.

Metallurgy and related subjects are taken in the Department of Metallurgy. Instruction in mechanical engineering, so important to the chemical engineer, is given by the Mechanical Engineering Department. Mechanical drawing and the laying out of machine elements in the Sophomore year are followed in the Senior year by the calculations for, and design of some such pieces of machinery as jaw crushers and stirrer autoclaves. In the interim Mechanical Engineering is developed in Steam and Gas Engines of the Sophomore year, in the Engineering Laboratory of the Junior and Senior years and in the Engineering Laboratory of the summer term following the Junior year. A first acquaintance with Constructive Elements

of Machinery and of Electrical Apparatus is acquired in the summer term following the Freshman year. An elementary course in the Mechanics of Materials accompanies the instruction of the first term of the Sophomore year. Many of the problems and innovations of Chemical Engineering demand a more intimate knowledge of the principles and practice of Electrical Engineering than is given in the general course in Physics; this is provided for in the Junior year under Advanced Electricity and Magnetism of the Department of Physics, and under Dynamos and Motors and Alternating Currents, with their laboratory adjuncts, of the Department of Electrical Engineering. A comprehension of the scope and general methods of Geology and Bacteriology is attained in short courses in these subjects. Bacteriology is a lecture and laboratory course, and a working knowledge of bacteriological methods as applied to water and some industrial products is achieved.

In addition to the usual courses in English of the beginning years, a course in English is provided for the Senior year, by which time, it is hoped, the student will have a mature appreciation of literary values. The study of German, a necessary tool in current chemistry, is carried by all students in the Freshman year, and provision is made for needful knowledge of French. Students who present German or Spanish for entrance take French in the Senior year, and those who present French for entrance take additional German in the Senior year.

An approach to the affairs of men and the problems of business and civilization is carried in some period of all four years, and is under the direction of the Head of the College of Business Administration. The full course of lectures in Economics as given in the University is placed in the Junior year. Related reading is specified as summer work, and examination in this requirement is held on the first Saturday following the opening of the first term. Summer reading comprises such matter as origins of industry and their relation to science, industrial management, business law and custom and contracts.

A scientific society is attached to the Department, with a membership of teachers and students, for the presentation of papers, discussion of current journals, and the entertainment of speakers of note in the profession of chemical engineering.

The degree granted on completion of the course is Chemical Engineer (Ch.E.).

THE COURSE IN CHEMICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Chemistry (1)	394
Chemistry Lab. (2)	391	Qualitative Analysis (3)	395
Elementary Mechanics (3)	320	Qual. Anal. Conf. (1)	396
Dr. & El. Mach. Des. (3)	200	Stoichiometry (1)	397
German (3)	72 or 76	Elem. Mech. & Heat (3)	321
English (2)	120	Phys. Measurements (1)	322
Mil. Sci. & Tactics (2)	470	Elem. Mech. Materials (1)	169
Military Drill (½)	470	German (3)	72 or 76
Gymnasium (½)	500	English (2)	122
		Mil. Sci. & Tactics (2)	470
		Military Drill (½)	470
		Gymnasium (½)	500

SUMMER TERM: Con. Elements of Mach. and of Elec. Apparatus, 201, 350, or industrial work (3). Summer Reading in Economics (1), 30.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus & Solid Analytic Geom. (4)	146	Integral Calculus (4)	147
Chemical Philosophy (3)	398	Advanced Chemistry (3)	399
Quantitative Analysis (3)	400	Quantitative Analysis (3)	404
Quant. Anal. Conf. (1)	402	Quant. Anal. Conf. (2)	405
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
Machine Design (2)	202	Steam & Gas Engines (4)	207
English (2)	123	Mil. Sci. & Tactics (2)	471
Mil. Sci. & Tactics (2)	471	Military Drill (½)	471
Military Drill (½)	471	Physical Education (½)	500
Physical Education (½)	500		

SUMMER TERM: Assaying, 413, and Industrial Mineralogy (3), 414. Summer Reading in Economics (1), 30.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Quantitative Analysis (2)	406	Organic Chemistry (4)	410
Quant. Anal. Conf. (2)	407	Organic Chem. Lab. (4)	411
Organic Chemistry (3)	408	General Metallurgy (2)	244
Organic Chem. Lab. (2)	409	Metallurgy of Iron (2)	245
Advanced Elec. & Mag. (2)	328	Met. Problems (1)	246
Dynamos & Motors (2)	354	Alternating Currents (2)	375
Dynamo Lab. (1)	355	Dynamo Lab. (1)	356
Engineering Lab. (2)	210	General Geology (2)	268
Economics (3)	16	Economics (3)	17
Physical Education (1)	500	Physical Education (1)	500

SUMMER TERM: Engineering Laboratory (3), 212. Summer Reading in Economics (1), 30.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Physical Chemistry (3)	419	Physical Chemistry (2)	421
Physical Chem. Lab. (1)	420	Physical Chem. Lab. (1)	422
Industrial Chem. Lab. (3)	412	Industrial Chemistry (3)	415
Non-ferrous Met. (4)	251	Research Chem. Lab. (2)	423
Met. Problems (1)	252	Industrial Analysis (3)	416
Engineering Lab. (1)	216	Industrial Anal. Conf. (1)	417
Bacteriology (2)	296	Sanitary Chem. Lab. (2)	418
Electrochemistry (1)	253	Electrometallurgy (1)	254
Electrochemical Lab. (1)	255	History of Chemistry (1)	424
Machine Design (2)	209	French (3)	105
Physical Education (1)	500	or German (3)	73
		English (2)	136
		Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

THE COURSE IN SHIP CONSTRUCTION AND MARINE TRANSPORTATION

The requirements for admission to the Course in Ship Construction and Marine Transportation are given on page 19.

The purpose of this course is to prepare men to engage in the design, construction and operation of ships, and to enter the field of marine transportation. The course is a combination of engineering and economics preceded by the fundamental subjects common to engineering courses: chemistry, modern languages, physics and mathematics. Combining, as it does, engineering training with studies in economics and business administration, such a course offers great advantages. It has been planned to develop a class of men, who in addition to a knowledge of conditions governing ocean and inland water transportation, will have a command of the technical, economic, and financial problems of ship design, construction and operation.

The first and second years are devoted largely to physics, modern languages, chemistry, engineering drawing, and mathematics, all of which afford necessary preparation for the technical work in later years. The course in Construction of the Freshman year is designed to give a general idea of the scope of engineering. Students continue in the Freshman year the modern foreign language accepted for entrance. In the Sophomore year they may elect French, Spanish or German.

The second year schedule, although largely concerned with science, embraces some preliminary work in engineering and economics. There is a detailed study of ship construction, including lectures and class room work covering the main features of ship construction, and also work in the drawing room where drawings of ship construction are worked up by the student. In the second term the student fairs up a set of ship's lines and cuts a model from his own lines. Both the transverse and longitudinal types of construction are given full treatment in this course. The study of naval architecture is begun in the second term of the second year and is continued in the first term of the Junior year.

The Junior year schedule includes these fundamental engineering subjects: Strength of Materials, Hydraulics, Naval

Architecture, Steam Engineering, Machine Design, Marine Engineering, and Electrical Engineering. Class room work in most of the subjects is supplemented by exercises in the laboratories. In the first term of the third year a study is made of the theory of heat engineering and thermodynamics. This course is followed in the second term by a study of marine engineering with special emphasis on the selection and layout of the marine power plant and economic problems in marine engineering.

The work in the Senior year completes the work in Naval Architecture and takes up the study of Ship Design, Marine Engines and Turbines, Metallurgy, Structural Steel Design and Reinforced Concrete, economics, and marine transportation.

An important feature of the Lehigh Course in Ship Construction and Marine Transportation is the large amount of time devoted to the study of economics and allied subjects. To arouse the student's interest and to fit him for work in marine transportation and foreign trade, instruction in Economics and Accounting is given in the Sophomore year, followed by Business Law and Finance in the Junior year, and by Marine Insurance and Foreign Exchange, Foreign Trade, and Industrial Management in the Senior year.

Surveying is given during four weeks of the summer term immediately following the close of the Freshman year.

Students are required to do summer work in shipyards and on shipboard, and the department co-operates in finding po sitions for them. The summer following the Sophomore year is spent in a shipyard. This brings the student into direct contact with practical ship construction and shipyard practices, so that he unconsciously acquires a knowledge of proportions and dimensions of engineering structures. The summer following the Junior year is spent at sea so that the student may observe the action of a ship at sea, and study the operation of the ship's power plant.

A pamphlet, giving further details, may be obtained by addressing the Registrar.

Graduates of this course receive the degree of Naval Engineer (N.E.).

THE COURSE IN SHIP CONSTRUCTION AND MARINE TRANSPORTATION

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Qualitative Analysis (3)	395
Chemical Lab. (2)	391	Stoichiometry (1)	397
Elementary Mechanics (3)	320	Elem. Mech. & Heat (3)	321
French (3)	94	Physical Measurements (1)	322
or Spanish (3)	111	French (3)	94
or German (3)	75	or Spanish (3)	111
Engineering Drawing (3)	160	or German (3)	75
Construction (1)	162	Engineering Drawing (2)	161
Mil. Sci. & Tactics (2)	470	Construction (1)	163
Military Drill (½)	470	Mil. Sci. & Tactics (2)	470
Gymnasium (½)	500	Military Drill (½)	470
		Gymnasium (½)	500

SUMMER TERM: Land and Topographic Surveying (3), 164.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus & Solid Analytic Geom. (4)	146	Integral Calculus (4)	147
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
English (2)	123	English (2)	124
French (3)	91 or 95	French (3)	91 or 95
or Spanish (3)	110 or 113	or Spanish (3)	110 or 113
or German (3)	70, 78	or German (3)	71, 79
Ship Construction (3)	450	Naval Architecture (2)	452
Economics (2)	16	Ship Construction (2)	451
Mil. Sci. & Tactics (2)	471	Accounting (2)	20
Military Drill (½)	471	Mil. Sci. & Tactics (2)	471
Physical Education (½)	500	Military Drill (½)	471
		Physical Education (½)	500

SUMMER TERM: Work in Shipyard on Hull Construction (3).

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Strength of Materials (4)	167	Hydraulics (3)	171
Strength of Materials Lab. (1)	168	Hydraulic Lab. (1)	172
Naval Architecture (3)	453	Alternating Currents (2)	375
Dynamos & Motors (2)	354	Dynamo Lab. (1)	356
Dynamo Lab. (1)	355	Marine Engineering (3)	455
Heat Engineering (3)	225	Machine Design (3)	202
Business Law (2)	31	Steam Engineering Lab. (1)	211
Astronomy & Navigation (2)	150	Finance (2)	18
Physical Education (1)	500	Economic Geography (3)	35
		Physical Education (1)	500

SUMMER TERM: At Sea or in Shipyard Machine Shop (3).

SENIOR YEAR

FIRST TERM		SECOND TERM	
Naval Architecture (2)	454	Metallurgy (3)	247-249
Ship Design (3)	457	Ship Design (4)	458
Marine Engs. & Turbines (4)	226	Reinforced Concrete (3)	185
Steam Engineering Lab. (1)	216	Contracts & Specifications (2)	184
Structural Steel Design (4)	456	Foreign Trade (4)	29
Industrial Management (2)	24	Shipyard Plants & Terminal Facilities (3)	459
Foreign Exchange & Marine Insurance (3)	28	Physical Education (1)	500
Physical Education (1)	500		

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

LIST OF STUDIES

Following is a complete list of studies offered by the University in its various courses. The number of exercises a week in each subject is indicated by the figures in parentheses. Two hours of drawing, three of work in the laboratory or three of practice in the field are regarded as equivalent to a recitation or lecture of one hour's duration.

UNDERGRADUATE COURSES

PHILOSOPHY, PSYCHOLOGY AND EDUCATION

PROFESSOR HUGHES, ASSISTANT PROFESSOR DROWN

1. GENERAL PSYCHOLOGY. Physiological Psychology, Hunter, first term; *Social Psychology*, MacDougall, second term. A course for B.A. students. First and second terms (3).

2. PRINCIPLES OF PSYCHOLOGY. *General Psychology*, Hunter, first term; readings in applied psychology, with special emphasis on MacDougall's *Social Psychology* and Link's *Employment Psychology*, second term. A course for Business Administration students. First and second terms (2).

3. PSYCHOLOGICAL PROBLEMS. Measurement of intelligence. studies in genius and in mental deficiency and abnormality. First term (2).

4. SOCIAL PSYCHOLOGY. The group mind. The relation to essential human needs of the several forms of culture,—sport, art, the moral and religious consciousness, the spirit of science; their origin and development. Second term (2).

5. ECONOMIC PSYCHOLOGY. An introduction to such works as Link's *Employment Psychology*. Tead's *Instincts in Industry* and texts on advertising and salesmanship. A course especially intended for students in engineering. First or second terms (1).

6. EXPERIMENTAL PSYCHOLOGY. A course for Seniors who wish to follow up some line of investigation touched on in the Junior year. First and second terms (1).

PHILOSOPHY

7. HISTORY OF PHILOSOPHY. An introduction to the philosophical method of dealing with the essential problems of an epoch. Rogers' *Student's History*. First term (2).

8. History of Philosophy, continued. The philosophical enterprises of recent years. Perry's *The Present Conflict of Ideals*. Second term (2).

9. Scientific Method. *Essentials of Logic*, Sellars; "*How We Think*," Dewey. Sophomores. Second term (3).

EDUCATION

10. History of Education. Special emphasis upon Greek education and upon the roots of our present educational systems and methods. Graves. First term (3).

11. Introduction to High School Teaching. A preliminary discussion of teacher and adolescent as the personal factors of the problem. The conduct and routine of class room practice, methods, types of lesson, daily plans, questions, devices and illustrative material, economy in teaching, discipline, tests, reports, etc. Colvin's *Introduction to High School Teaching*. Collateral readings. Juniors. First term (3).

12. Principles of Secondary Education. The fundamentals of method, including the philosophy of the project method. Dewey, Kilpatrick, Thorndike and Hosic. Problems of administration, including a study of the development of secondary school systems, junior high schools and junior colleges. Social factors. Problems of the curriculum. Inglis' *Principles of Secondary Education*. Juniors. Second term (3).

13. Senior Education. Preparation for the type of teaching position the student expects to fill. Special Method: in Latin, course 54, Professor Blake; in German, courses 81 and 82, Professor Palmer; in Romance Languages, course 96, Professor Fox; in Physics, course 336, Professor MacNutt. Specialization in certain other fields under the supervision of a competent teacher in nearby public or private schools, as stated on page 38. Observation with practise teaching is required of all students taking this course. First and tecond terms (3).

14. Practise Teaching. Work in connection with other courses and extra work. The student who seeks the State Department's provisional college certificate to teach (see page 37) should take practise teaching yielding at least five term hours of college credit. Three of these hours may be supplied by work in courses 10 and 11 and two to four hours by work in

course 12. Extra work along desired lines may be arranged, yielding credit of one term hour in any given term. (1.)

15. Science and Scientists. Given during 1919-1920 and 1920-1921 as part of course 47. The intellectual development of man revealed as the underlying cause of social and political progress. Libby's *An Introduction to the History of Science.* First and second terms (1).

BUSINESS ADMINISTRATION

PROFESSOR STEWART, PROFESSOR FOX,
ASSOCIATE PROFESSOR BICKLEY, ASSISTANT PROFESSOR CURTIS,
MR. MAC GREGOR

ECONOMICS

16. Economics. A study of the elementary principles of political economy. Lectures and required reading in selected works. First term (3) or (2).

17. Economics. Practical economic problems; taxation, transportation, finance, labor, trusts, and monopolies. Second term (3).

18. Business Finance. A study of the financial needs of the different forms of industrial organization, including individual proprietorship, partnership, corporation, and holding company, together with various means of meeting these needs. Second term (2).

18a. Corporation Finance. A study of the means of financing a corporation, including the sale of commercial paper, common and preferred stock, debenture and mortgage bonds, promotion of new corporations, underwriting, re-organization and receivership. First and second terms (3).

19. Public Finance. Government expenditures and their relation to the functions of government and to social, political and industrial conditions; formulation of budgets; nature and employment of public credit; origin and growth of public debts; revenues from various sources, with reference both to the theory and to the practise of various nations. First and second terms (3).

20. Accounting Theory and Practice. A study of the fundamental principles of accounting with sufficient practise work to illustrate these principles. Theories of debit and credit; single and double entry; construction of accounts; special books; dis-

tinction between capital and revenue and the problem involved; construction and analysis of financial statements; equity accounts; valuation of assets; methods and problems of depreciation. The economic aspects of accounting are emphasized. First term (3), or second term (2).

21. Corporation Accounting. (Elective, Junior year.) The application of accounting principles to corporations, corporation accounts and records. The voucher system; construction and analysis of corporate statements and reports; assets of corporations and their valuation; capital stock and the stock books; bonds and other forms of indebtedness; distribution of profits; handling surplus and reserves; sinking and other funds; liquidation of a corporation; combinations and consolidations; branch house accounting. Considerable practice work is given during the second term. The problems are selected largely from examinations for Certified Public Accountancy. First and second terms (3).

21a. Auditing. (Elective, Senior year.) Procedure in conducting an audit; detection of errors and defalcations; financial conditions of a business as revealed by the accounts and other sources of information. The social responsibilities of auditing. First term (3).

21b. Manufacturing Accounts. (Elective, Senior year.) The various systems of manufacturing accounts for different types of manufacturing enterprises; choice of methods to meet peculiar needs; installing cost systems; forms and records; manufacturing accounts as an aid to and as a check on production efficiency; preparation of reports for executives. Second term (3).

22. Transportation. Development of transportation facilities. Consideration, from the administrative viewpoint, of railways and waterways as factors in the social and industrial development of the United States. The organization of railways, considering charters and franchises, capital stock, directors and stockholders. The administration and operation of railways, considering the activities of the various departments,—transportation, traffic, executive, financial, and legal. Relations between railroads and their employees. Public regulation and control of transportation facilities. First and second terms (2).

23. Labor Legislation and Administration. Labor problems confronting the employer and the more successful methods of meeting them and avoiding legal disputes. The legal status of unions and strikes. Protection of the employer's interests. Employer's Liability and Workmen's Compensation Acts. First and second terms (3).

24. Development of Economic Thought. The rise and development of economic systems and economic thought; the scope and method of political economy. Patten's *Development of English Thought* and the works on political economy of Keynes, Cohn and Ingram are used. First and second terms (3).

25. Investments. A comparative study of investment values (including bonds, stocks, notes, and mortgages) and the conditions affecting the investment market; with the emphasis on the securities of corporations as investments. First and second terms (3).

26. Statistics. Statistical method and applied statistics. Practice is given in the handling and especially in the interpretation of statistics. As much research as possible is carried on. First and second terms (3).

27. Banking and Currency. A study of the banking system of the United States, comparing it with those of the important European states, together with a study of the currency and currency problems of this country. Special emphasis is laid upon the Federal Reserve Act, foreign exchange, and factors affecting the money market. First and second terms (3).

28. Foreign Exchange and Marine Insurance. Foreign monies and exchange ratios, financing of exports and imports, factors determining exchange rates, statistical studies in the field of foreign exchange, instruments and forms used in foreign trade; principles of insurance and the peculiarities of marine risks and policies. First term (3).

29. Foreign Trade. An historical and statistical study of international trade; the organization of steamship lines; combines, export associations, and rate agreements; line and charter traffic and trade routes. A study of steamship ports and the influence of the hinter land with special attention to the relations of navigation or inland waterways and railway transportation to ocean commerce. The course also includes a study of the special methods necessary for successful trading with certain undeveloped but progressing nations. Second term (4).

30. Summer Reading in Economics. Assignments for summer of 1921. Freshman: Resources. *The Conservation of Natural Resources*, Charles R. Van Hise. Sophomore: Industrial Society. *Readings in Industrial Society*, Leon C. Marshall. Junior: Industrial Administration. *The Works Manager Today*, Sidney Webb; *Organizing for Work*, H. L. Gantt; *Instincts in Industry*, Ordway Tead.

LAW AND POLITICAL SCIENCE

31. Elements of Business Law. The principles of contract; formation of contracts; operation and discharge of contracts; sales of goods; insurance contracts; negotiable instruments. First term (2) or (1).

32. Elements of Business Law. Principal and agent; master and servant; business associations; partnerships and corporations. Second term (2) or (1).

33. Constitutional Law. The constitutional framework and the practical operation of the Federal and State governments. The relation of government to the business and social interests of the people. Interpretation of the Constitution by the various departments of the government. Comparison of American and European practice. First and second terms (3).

34. International Law. The development of international law; its origin and history; economic and political changes determining the development of international relations; the Jus Gentium of the Roman Law and the "Natural Law" jurists. Law of Peace and War: general principles governing the normal relations of states and their relations in time of war. The Law of Neutrality, with special reference to the contributions of the United States; problems associated with blockade, contraband of war, unneutral service. First and second terms (3).

ECONOMIC GEOGRAPHY

35. Economic Geography of North and South America. Physical features, climate, and resources of the Western Hemisphere; their influence upon the economic, political, and social institutions. The present and prospective commercial relations of the United States with Mexico, Central and South America. First and second terms (3).

36. Economic Geography of the Eastern Hemisphere. Physical features, climate, and resources of the Eastern

Hemisphere; their influence upon the economic, political, and social institutions. Study of Great Britain, Germany, Russia, China, Japan, India and the Philippine Islands; the present and prospective commercial relations of these countries with the United States. First and second terms (3).

HISTORY

PROFESSOR STEWART, MR. MAC GREGOR

38. INDUSTRIAL HISTORY. The evolution of modern industrial conditions as found in the growth of the economic powers of Great Britain, Germany and the United States. First and second terms (3).

39. THE POLITICAL AND CONSTITUTIONAL HISTORY OF THE U. S. PRIOR TO 1860. The era of constitution making, state and federal. Rise and growth of party government. The development of nationality and democracy. Political and constitutional questions arising in connection with internal improvements, the tariff, the bank and slavery. First and second terms (3).

40. POLITICAL AND CONSTITUTIONAL HISTORY OF THE U. S. SINCE 1860. A continuation of the preceding course. Given alternately with course 41. First and second terms (3).

41. EUROPEAN HISTORY. The formation of the modern European nationalities. The rise of the universities. The revival of learning. The Reformation. The relations of Europe and America. First term (3).

42. EUROPEAN HISTORY. The history of modern Europe. The development of Great Britain. The French Revolution and the history of the Nineteenth Century. Second term (3).

43. AMERICAN FOREIGN RELATIONS. Studies in the diplomatic relations of the United States with the main countries of Europe, with the Near East and the Far East. First term (3).

44. UNITED STATES AND LATIN AMERICA. Problems arising out of the relations of South American states to one another and to the United States. Origin, development and application of the Monroe Doctrine. Second term (3).

LATIN

PROFESSOR BLAKE

45. LIVY. Selections from the books covering the war with Hannibal. Particular attention to forms and the usages of

normal syntax. Latin prose compositions using Arnold's *Latin Prose*. Written translations from Latin into English. History of the struggle between Rome and Carthage. Freshman, first term (3).

46. HORACE. *Odes* and *Epodes*. Insistence upon tasteful translation. Constant practice in metrical reading. Memorizing of some of the odes of Horace. Latin prose composition, continued. Freshman, second term (3).

47. ANCIENT AND MEDIAEVAL LITERATURE AND HISTORY. A course aiming to impart a knowledge of ancient and mediaeval civilization and literature by means of required readings in available English translations of writings of the times, as well as by means of text-books dealing with the course of events. Freshman, first and second terms (3).

Courses 45 and 46 are required of Freshmen in the B.A. course who enter with four units in Latin; others in that course take 47, except that those who present three units in Latin for entrance may, upon the approval of the Professor of Latin, continue Latin instead.

48. PLINY. Selected letters. Tacitus. *Agricola* and *Germania*. Consideration of social and legal usages suggested by Pliny. Some study of Roman provincial administration. Sophomore, first term, elective (3).

49. PLAUTUS AND TERENCE. Careful study of a play of each, with rapid reading of as much more as time permits. Study of dramatic verse-structure and practice in metrical reading. History of the drama at Rome. Sophomore, second term, elective (3).

50. TACITUS. Selections from the *Histories* or *Annals*. Some consideration of Tacitus as an historian and a literary artist. Sight-reading from Suetonius. Junior or Senior, first term, elective (3).

51. JUVENAL. Selected *Satires*. Selections from Martial. Satire and epigram in Roman literature. Study of social conditions under the empire as evidenced by the writings of the younger Pliny, Tacitus, Suetonius, Juvenal, and Martial. Writing of brief dissertions on assigned topics. Junior or Senior, second term, elective (3).

52. ROMAN LAW. An elementary course. Reading and comment on selections from the Institutes of Justinian, or Gaius. Brief survey of Roman constitutional history and the develop-

ment and contents of the body of Roman Law, in connection with Morey's *Outlines of Roman Law*. Junior or Senior, first term, elective (3).

53. LUCRETIUS. Careful study of one book entire of *De Rerum Natura*, with reading of selections from the other books. Consideration of textual questions. Discussion of ancient materialistic theories. Some review of Roman philosophy and ethics. Junior or Senior, elective, second term (3).

54. Courses for prospective teachers of Latin in secondary schools. Largely a review of secondary school Latin, the members of the class conducting the class in turn under the oversight of the Professor of Latin to the end that they may enter upon the teaching of Latin in preparatory or high school with freshened knowledge of the subject, and not without some experience in presenting it. Junior year, first term (2), second term (2). This course will ordinarily be taken in connection with EDUCATION, which see.

GREEK

PROFESSOR GOODWIN

55. LYSIAS, Selected *Orations*; or XENOPHON, *Memorabilia*. Review of the Grammar. Composition and other exercises. Careful study of Attic prose syntax; special attention to the formation of correct methods of study and translation, to grammatical analysis, and the reading aloud of Greek. Available time is employed in sight-reading. HERODOTUS. One book begun. First term (3).

56. HERODOTUS (continued). Study of the forms and syntax of the Ionic dialect. PLATO. *Euthyphro* and *Apology*, or other shorter dialogues. Introduction to Greek Philosophy. Grammar and Composition as in the first term. Second term (3).

57. THUCYDIDES. One or more books. Practical exercises, including composition. First term (3).

58. TRAGEDY. EURIPIDES. *Medea*, *Bacchae*, or another play. SOPHOCLES. *Oedipus Tyrannus*, *Antigone*, or another. Literary study of the drama. Poetical language, style, and conception. Metrical reading. Composition. Second term (3).

59. Dramatic Poetry (continued). Aeschylus. *Agamemnon*, or *Prometheus Bound*. Aristophanes. *Clouds*, *Frogs*, or *Birds*. Aristotle. Chapters from the *Poetics*. Aristophanes as humorist and as moralist, with consideration of the tendencies which he satirized. Metres. Elementary text-criticism. First term (3).

60. Greek Oratory. Jebb's *Selections from the Attic Orators*. Demosthenes. Selected orations. Rapid reading, the student being supposed to have reasonable facility in understanding the Greek directly without rendering into English. Attention is directed largely to those points which illustrate the development of Greek prose style. Second term (3).

61. Homer. Rapid reading of considerable portions of the *Iliad* or *Odyssey*. Homeric language, syntax, and metre reviewed, with some reference to the needs of intending teachers, but chiefly as a foundation for the study outlined in course 62. First term (3).

62. Lyric Poetry. Fragments of the Elegiac, Iambic, and Melic Poets. Selections from Pindar or Theocritus. Study of the development of poetry in Greece. Second term (3).

63. Hellenistic Greek. *New Testament*. Selections from Lucian. To be substituted on occasion for 62. Second term (3).

Courses 59 and 61, 60 and 62 are given in alternate years, and are open to both Juniors and Seniors.

Candidates for honors in Greek will be assigned special readings on request.

64. Elementary Greek. A course offered in alternate years to Freshmen or Sophomores who have entered without Greek, but desire to take up the study in college. They perform in two years approximately the amount of work required for admission from those who present Greek, and are prepared to proceed in the third year with course 55. The introductory book and a portion of the *Anabasis* are studied in the first two terms. Given in 1920-1921; to be omitted in 1921-1922. First and second terms (3).

65. Elementary Greek, second year. *Anabasis* continued; *Iliad*; Grammar and simple Composition. Omitted in the years in which the preceding course is given. First and second terms (3).

GERMAN

PROFESSOR PALMER,
ASSISTANT PROFESSOR MORE, MR. ROEST

70. ELEMENTARY GERMAN. German Grammar and Composition. Easy German texts. First term (3).

71. ELEMENTARY GERMAN, continued. Composition based on work in the Grammar. Dictation. Reading of short stories by various modern authors. Second term (3).

72. ELEMENTARY GERMAN. A condensed course for Chemical Engineers who have entered without German. Grammar. Readings in the German of Chemistry. First and second terms (3).

73. GERMAN. Rapid reading of selected texts on chemistry. For Sophomores who have passed course 72. First term (1).

74. SCIENTIFIC GERMAN. Rapid reading of scientific texts. For Seniors in the Department of Chemical Engineering who offered French or Spanish for entrance. Prerequisite course 72 or equivalent. Second term (3).

75. GERMAN. Thorough review of German Grammar. Prose composition. Modern German Prose; Scientific German. First and second terms (3).

76. GERMAN. The German of Chemistry. Review of German Grammar. Composition. First and second terms (3).

77. GERMAN. German Prose and Poetry. Heine, Keller, C. F. Meyer, Freytag, Storm, Heyse. Composition. First and second terms (3).

78. GERMAN. Modern German Prose. Rapid reading of representative texts. First term (3).

79. GERMAN. Goethe's *Faust*. Study of Part I. Lectures on the origin and development of the Faust story. Second term (3).

80. GERMAN. Nineteenth Century German Drama. Lectures, reading, reports on assigned work. First and second terms (3).

81. GERMAN. Goethe's Dramas: *Goetz, Egmont, Iphigenie, Tasso, Faust*, Part II. First and second terms (3).

82. GERMAN. The German Short Story, its origin and development. Rapid reading of illustrative stories, with particular attention to Gottfried Keller, Theodor Storm, C. F. Meyer, and Paul Heyse. Lectures and reports. First and second terms (3).

83. GERMAN. A course for prospective teachers in advanced German grammar, German composition, methods of teaching and discussion of text-books. First term (2).

ROMANCE LANGUAGES

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY, MR. CANONICO, MR. EWING

FRENCH

90. ELEMENTARY FRENCH. Elementary French Grammar. Easy readings in French prose. Practice in speaking and writing simple French, based upon the texts used. A course intended primarily for Junior students in the College of Arts and Science; introductory to course 97. First and second terms (3).

91. ELEMENTARY FRENCH. An elective for Sophomore students in the course in Ship Construction and Marine Transportation. Emphasis upon the development of a reading knowledge of French. Grammatical drill limited to the essentials. First and second terms (3).

92. ELEMENTARY FRENCH. A Sophomore elective for students in the College of Arts and Science who wish three years of French and can therefore give time to a more detailed drill in grammar and composition as well as practice in writing and Science; introductory to course 97. First and second terms (3).

93. FRENCH. A course for students who wish a greater opportunity to practice in the oral and written use of modern French prose. Especially recommended for those who expect to teach French. First and second terms (2).

94. FRENCH. A course for Freshmen who enter on French. Thorough review of the grammar with composition work, both oral and written, based upon the grammar and upon the texts read. Texts selected from writers of modern French prose. First and second terms (3).

95. FRENCH. Primarily for students in Ship Construction and Marine Transportation who elect to continue the French of their Freshman year. Rapid reading of modern French authors, introducing certain of the social and political problems of France and her people today. Reading of texts by such authors as Thiers, Lamartine and Michelet, to furnish the necessary background. First and second terms (3).

96. FRENCH. Text and methods. First or second term, or both (1) or (2).

97. FRENCH. Rapid reading. Sight translation. Dictation. Oral drill in the use of a practical vocabulary. First and second terms (3).

98. FRENCH PROSE AND POETRY. Balzac, Flaubert, Maupassant, Daudet, Zola. First term (3).

99. FRENCH PROSE AND POETRY. Continuation of course 98. Molière, Corneille, Racine. Society in the seventeenth century. Second term (3).

100. FRENCH. French literature in the seventeenth century. First term (3).

101. FRENCH. French literature in the eighteenth century. Second term (3).

102. FRENCH. French literature in the sixteenth century and earlier. First and second terms (3).

103. FRENCH. General review of French Literature. Reading, lectures and explanation of texts. First and second terms (3).

104. FRENCH. French literature in the nineteenth century. First and second terms (3).

SPANISH

110. SPANISH. Grammar, reading and composition. A course open to all students of the University. First and second terms (3).

111. SPANISH. Preparation required: 110 or equivalent. Reading and discussion in Spanish of texts dealing with the history of Latin American countries. Prose Composition. First and second terms (3).

112. (Alternate.) Spanish novels and plays. Short outline of Spanish literature. A second year course, intended more especially for students in the B.A. course; may be substituted by them for course 111, dealing with Latin America. First and second terms (3).

113. SPANISH. Reading and discussion in Spanish of texts dealing with the commercial and industrial relations of Latin America. Spanish commercial correspondence. First and second terms (3).

PORTUGUESE

114. PORTUGUESE. Grammar and composition. Rapid reading of modern literature, with particular reference to the

history, social and economic conditions of Brazil and Portugal. First and second terms (3).

115. Portuguese. A continuation of course 114. First and second terms (3).

ITALIAN

116. Italian. Grammar and composition. Rapid reading of easy modern prose. First and second terms (3).

117. Italian. Masterpieces of the classic periods; outside reading. First and second terms (3).

ENGLISH

PROFESSOR THAYER, PROFESSOR LUCH,
ASSISTANT PROFESSOR MESCHTER, ASSISTANT PROFESSOR WALTERS,
MR. LAMBERT

120. Rhetoric. A composition course based on Genung's *Working Principles of Rhetoric* and other books, involving recitations and weekly themes on assigned subjects. First term (2).

121. American Literature. Lectures on the basis of Cairns' *History of American Literature* and other text-books, as assigned. The examination is based upon the text-book and the student's notes. First term (1).

122. History of the English Language. Lectures and classroom work, with the use of Emerson's *Brief History of the English Language* as a text-book, supplemented by Lounsbury's and Champneys'. Second term (2).

123. English Literature. An outline course developed by lectures and recitations, with parallel readings assigned annually. Text-book: Pancoast's *English Literature* with a standard book of selections from English Literature. First term (2).

124. Literary Criticism. Subject varies annually between topics taken from Elizabethan Literature, lyric or dramatic, and from Nineteenth Century Literature, earlier or later period. Second term (2). In 1922, Byron, Shelley, Keats and Landor.

125. Oratory. A formal course based upon Foster's *Argumentation*, with recitations and writings of briefs, the composition and delivery of orations, and speeches on topics of current interest. First and second terms (1).

126. Anglo-Saxon. Sweet's *Anglo-Saxon Primer and Reader*, with lectures on early English Literature, and readings from Brooke and Earle. First term (3).

127. Journalism. A course of practical exercises in writing on scientific subjects and in the principles of journalism. Text-books: Bleyer's *Newspaper Writing and Editing* and Earle's *Technical Writing*. First term (3), repeated in second term (3).

128. English Philology. The principles of the Philology of the English language as developed in the works of Earle, Trench, Morris and Skeat. By a process of elimination the elements derived from Romance and other sources are excluded, and the residuum examined, in vocabulary and grammar, as a Teutonic language; with special reference to the intensive development of the tongue before the Age of Chaucer. Preparation required: 126. Second term (3).

129. Nineteenth Century Literature; later period 1830-1892. A special study of Tennyson, Arnold and Browning and some of the minor poets. First term (1).

130. Middle English. A critical study of the English of Chaucer, Langland, Wiclif and Gower; followed by the literary study of selected specimens of their works. As text-books, *The Student's Chaucer*, Skeat's edition of *The Vision of Piers the Plowman*, Wiclif's translation of the *New Testament*, revised by Purvey, and Gower's *Confessio Amantis* are assigned. First term (3).

131. Poetics. A course based on Gummere's *Handbook of Poetics*, Alden's *English Verse*, Saintsbury's *Loci Critici*, and the use of Palgrave's *Golden Treasury*, and *The Oxford Book of English Verse*, with practical exercises in verse-composition. Second term (3).

132. Drama of the Past. Based on Brander Matthew's *Chief European Dramatists*; with lectures, interpretations and a close study of plots and sources. First term (3).

133. Contemporary Drama. Lectures, criticisms and reading of typical plays. In 1922, American Drama. Second term (1).

134. The Danish Element in English. A philological study based on Sweet's *Icelandic Primer*, Groth's *Danish Grammar* (pp. 1-29, 67-143) and the works of Jespersen and other philologists. Alternative with 130. Preparation required: 126, 128. Second term (3).

135. Optional courses on the Rise and Development of the English Novel and on the Arthurian Cycle offered in alternate years. These are both lecture courses, with private reading assigned; and if supplemented by a rigid examination, will be taken as equivalent to one term's work in any class above the grade of Freshman.

136. English Conferences. Second term (2).

MATHEMATICS AND ASTRONOMY

PROFESSOR THORNBURG, PROFESSOR LAMBERT, PROFESSOR OGBURN, ASSISTANT PROFESSOR STOCKER, ASSISTANT PROFESSOR REYNOLDS, ASSISTANT PROFESSOR KNEBELMAN, DR. LEYZERAH, MR. SOLT, MR. BUNN

140. Solid Geometry, beginning with Book VI and completing the subject. Second term (3).

141. Trigonometry. Plane Trigonometry, including the theory and use of logarithms. First term (3).

142. Trigonometry. Spherical Trigonometry, including the use of logarithmic tables. Second term (1).

143. Advanced Algebra, beginning with the Theory of Quadratic Equations. Review of Plane Trigonometry. First term (3).

144. Higher Algebra. Theory of Equations and other topics. First term (1).

145. Plane Analytic Geometry. Graphic representation of loci on cross-section paper, plane analytic geometry. Second term (3).

146. Differential Calculus and Solid Analytic Geometry. Embracing applications to analytic geometry and practical problems. Preparation required: 145. First term (4).

147. Integral Calculus. General integration methods with applications to theory of center of gravity, moment of inertia, together with a short chapter on elementary ordinary differential equations. Preparation required: 146. Second term (4).

148. Differential Equations. Preparation required: 147. First term (1).

149. Analytic Mechanics. Differential equations of motion, treatment of forces in space, free and constrained motion of a particle and of masses, with applications to practical problems. Preparation required: 147. First term (2).

150. Descriptive Astronomy. A study of the fundamental facts and principles of the subject with solution of problems; observatory visits. First and second term (2) or (3).

151. Practical Astronomy. Study of instruments used, methods of taking and reducing observations to determine time, latitude, longitude and azimuth; observatory work in which each student makes his own observations and computations in illustration of the problems studied. As this study is primarily for civil engineers, the sextant and engineer's transit are the chief instruments employed in the observational work. Preparation required: 147, 150. First term (3).

152. Analytic Mechanics. Preparation required: 147, 148, 149. Second term (3).

CIVIL ENGINEERING

PROFESSOR FOGG, PROFESSOR WILSON, PROFESSOR CHAPMAN, ASSISTANT PROFESSOR BECKER, ASSISTANT PROFESSOR FULLER, ASSISTANT PROFESSOR PAYROW, ASSISTANT PROFESSOR LEWIS, MR. UHLER

160. Engineering Drawing. The use of drawing instruments. Lettering and tracing. Mechanical drawing from objects. Simple projections. Isometric drawing. First term (3).

160a. Enginering Drawing. An abridgement of course 160 for students in Business Administration. First term (3).

161. Engineering Drawing. The descriptive geometry of projections, intersections, and developments. Plans, elevations and sections of simple structural details. Preparation required: 160. Second term (2).

161a. Engineering Drawing. An abridgement of course 161 for students in Business Administration. Second term (2).

162. Construction. Lectures planned to give the student a general view of various branches of engineering. Principal topics discussed: history and scope of engineering, the lives of some noted engineers and scientists; history and types of architecture; modern building construction, including steel frames and fire-proofing; masonry; materials of construction; water supply and sewage disposal; development and transmission of water power. First term (1).

163. Construction. Continuation of course 162. Second term (1).

164. Land and Topographic Surveying. The theory and practice of land surveying, including computation of areas, dividing land, determining heights and distances. Map drawing and topographic signs. Field work with level and transit. Map drawing from students' field notes. Theory and use of stadia. Detailed field work in rough country; pen topography and contour maps. Illustrations with and problems in the sand box. Preparation required: plane trigonometry and mechanical drawing. Summer term; a recitation and seven hours of field work or drawing each week-day for four weeks beginning June 15, 1921.

165. Stereotomy. Problems in stone cutting, including plans for piers, culverts, and arches. Isometric drawings and linear perspective. Preparation required: 160, 161. First term (3).

166. Graphic Statics. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to the discussion of beams and girders. First or second term (2).

167. Strength of Materials. The elasticity and strength of timber, brick, stone, and metals. Theory of beams, columns, and shafts, with the solution of many practical problems. Preparation required: 320, 321, 323, 147. First term (4).

168. Strength of Materials Laboratory. Fourteen experiments made by each student on wood, iron and steel to determine the action of materials under stress and to study the physical properties of materials of construction. The Fritz Engineering Laboratory, where this work is done, is equipped with 20,000, 50,000, 100,000, 300,000, and 800,000-pound machines for tension, compression, and flexure, a 50,000-inch-pound machine for torsion and other apparatus for special work. Preparation required: 167. First term (1).

169. Elementary Mechanics of Materials. Brief introduction to elements of strength of beams, columns and shafts, especially as applied to elementary machine design. First term (1), or second term (1).

170. Highway Engineering. The location, construction and maintenance of roads and pavements. Preparation required: 162, 163. First term (2).

171. Hydraulics. Hydrostatics and theoretical hydraulics. The flow of water through orifices, weirs, tubes, pipes, and channels. Naval hydromechanics. Hydraulic motors. The solution of many practical problems. Preparation required: 320, 321, 323, 147. Second term (3).

172. Hydraulic Laboratory. Fourteen experiments made by each student in the hydraulic section of the Fritz Engineering Laboratory, which is equipped with pumps, weirs, turbines, water-wheels, meters and other apparatus for special work. Preparation required: 171. Second term (1).

173. Roofs and Bridges. The theory and computation of stress in roof and bridge trusses under dead, live and wind loads. Locomotive wheel loads on plate girders and bridge trusses. Preparation required: 167. Second term (3).

174. Railroad Surveying. Reconnaissance, preliminary and location methods, with the theory of curves and turnouts. Location of a line, with the preparation of profiles and maps. The computation of earthwork and estimates of cost. Preparation required: 164. Second term (4).

175. Bridge Design. Lectures and recitations. Discussion of the theory of structural steel design and complete calculations for a through plate girder railroad bridge and for a highway truss bridge, both of which are designed and drawn in course 176. Preparation required: 173. First term (2).

176. Bridge Design Drawing. Complete shop drawing for a single track through railroad bridge and a design drawing of a highway truss bridge for which calculations are made in course 175. Preparation resuired: 173. First term (4).

177. Hydraulic Engineering and Design. Three recitations and one drawing-room exercise a week devoted to systems of water supply, including purification systems, reservoirs, pipe lines, pumping plants. The design of a water supply distribution system. The measurement of flow in open channels by means of tubes and meters. Water power. Irrigation. Preparation required: 171. First term (4).

178. Railroads. The construction of the roadbed; including ballast, crossties, rails, switches, culverts and other details. Maintenance of way, and the elements of railroad operation.

Visits of inspection, with written reports. Lectures on the economics of railroad location; the arrangement of yards, stations and terminals, train resistance, the application of electricity to the operation of railroads. Preparation required: 174. First term (2).

179. Geodetic Surveying. Recitations, calculations, field work. Precise leveling. Adjustment of instruments with investigation of their systematic errors. Elements of least squares and their application to the adjustment of triangulations. Field work in triangulation, in determination of azimuth, and with the plane table. Preparation required: 174. First term (3).

180. Mill Buildings. Design, construction and layout of mill buildings. Preparation required: 173. First term (2).

180a. Mill Buildings. An abridgement of course 180 for students in Mechanical Engineering. First term (2).

181. Bridges and Dams. Higher structures, including continuous, draw, cantilever and suspension bridges, also metallic arches. The theory and design of masonry walls, dams, and arches. Theory of deflections and applications to statically indeterminate structures. Preparation required: 175. Second term (4).

182. Sanitary Engineering. Systems of sewerage and methods of sewage treatment and disposal. The design of a sewerage system. House drainage. Preparation required: 177. Second term (3).

183. Reinforced Concrete. The manufacture, properties, and testing of hydraulic cement, mortar and concrete. All the standard tests made by each student on cement and on reinforced concrete beams and columns in the Fritz Engineering Laboratory. Reinforced concrete buildings, arches and other structures; theory of reinforced concrete. Preparation required: 175. Second term (4).

184. Contracts and Specifications. Lectures on the essentials of contracts and specifications for engineering structures. Second term (2).

185. Reinforced Concrete. An abridgement of No. 183 for students in Ship Construction and Marine Transportation. Second term (3).

SUMMER SCHOOL IN CIVIL ENGINEERING

164. Land and Topographic Surveying. Exercises in Land Surveying and Topographic Surveying, designed primarily for students of the University, but open to all persons prepared to take them, are given in the summer vacation. In 1921, this work begins at 8 a.m., on June 15, and ends on July 12. Students in Civil Engineering, Mining Engineering and in Ship Construction and Marine Transportation are required to take this work at the end of their Freshman year. The fee for other persons is $20.

SUMMER WORK IN CIVIL ENGINEERING

During each summer following the Sophomore and Junior years students are required to spend at least eight weeks on shopwork or on engineering construction.

MECHANICAL ENGINEERING

PROFESSOR LARKIN, PROFESSOR DE SCHWEINITZ,
PROFESSOR KLEIN, ASSOCIATE PROFESSOR BUTTERFIELD,
ASSISTANT PROFESSOR BEAMENSDERFER,
ASSISTANT PROFESSOR QUAST, MR. NORDENHOLT

200. Drawing and Elements of Machine Design. Orthographic, isometric and oblique projections, intersections and developments. Sketches and working drawings of machine pieces, tracings, details of screw-fastenings, keys and other fastenings. Students taking this course are required to take course 169, Elementary Mechanics of Materials. Text-book: French's *Engineering Drawing*. First term (3).

201. Constructive Elements of Machinery. Visits of inspection. Examination and sketching of machine parts and machinery. Inspection and study by each student of a classified and numbered list of some three hundred and sixty items. Taking apart and putting together of a score of machines of all sorts. Work accompanied by Constructive Elements of Electrical Apparatus, course 350. Summer term four weeks beginning June 15, 1921.

202. Elements of Machine Design. Calculation of the dimensions of elementary machine parts such as spur-, bevel- and worm-gears, pulleys, shafting, couplings, bearings, connecting rods, etc., from the forces acting upon or transmitted by such machine parts. Working drawings of these pieces.

Text-book: Leutwiler's *Elements of Machine Design.* Preparation required: 169 and 200. First or second term (3).

203. Boilers. Description of various types, and details of construction, staying, setting, etc.; strength of the structure; accessories. Textbook: Peabody and Miller's *Steam Boilers.* First term (1).

204. Steam Engines. Classification and types of engines, governors, valve gears; valve diagrams, indicator diagrams, efficiency. Fuels, combustion, boilers, superheaters, feed water heaters, condensers. Text-book: Hirshfeld and Barnard's *Heat Power, Engineering.* Second term (4).

205. Heat Engines. Short course for students in courses other than Mechanical Engineering, covering Steam Engines, Steam Turbines, Internal Combustion Engines and Boiler Plants. Text-book: Hirshfeld and Barnard's *Heat Power Engineering.* First term (3).

206. Heat Engines. Work of 205 completed. Second term (3).

207. Steam and Gas Engines. A combination of courses 205 and 206 for students in the Chemical Engineering course. Second term (4).

208. Mechanical Technology. Full written description required of the various processes, operations, and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings and finished pieces, which are under construction in the shops at the time. Personal direction of the student's work by an instructor, who accompanies him in each shop. Summer term, four weeks, beginning June 15, 1921.

209. Graphic Statics of Mechanisms. Graphical determination of the forces acting on all the various pieces constituting a machine, covering a great variety of machines; drawings of these machines given to the students. Consideration of frictional and inertia resistances and determination of the efficiencies of mechanisms. First or second term (2).

210. Engineering Laboratory. Use and calibration of apparatus for measuring weight, volume, pressure, temperature, speed, etc., for engineering purposes. Text-book: Carpenter & Diederich's *Experimental Engineering.* Fee, $3.50. First term (2).

211. Engineering Laboratory. Work of 210 continued. Indicator practise on engines in the laboratory and in factories and power plants in the neighborhood; complete working up of indicator diagrams from simple and compound engines, air compressors, etc. Text-book: Carpenter & Diederich's *Experimental Engineering*. Fee, $3.50. Second term (1).

212. Machinery of Transmission. Treatment of the Mechanics of Machine Parts and determination of their dimensions from considerations of strength and durability. Analytical presentation of the subject of acceleration. First term (3).

213. Thermodynamics. Proof of the fundamental laws; equations of condition for air and superheated steam; the relation between pressure, volume, temperature, work and heat for special changes of state. Establishment of the fundamental equations of thermodynamics and their adaptation to gases, saturated and superheated vapors, and technical problems connected therewith. First term (4).

214. Kinematics of Machinery. A treatment of the constrained motion peculiar to machinery and of the nature and equivalence of mechanisms. Lectures, accompanied by a large amount of work in the drafting room. The construction of centrodes; inversions and skeletons of mechanisms; preparation of displacement, velocity and acceleration diagrams for a great variety of machines. Much practise in mass and force reductions, the latter including all forms of inertia resistance and external forces. Text-book: A. W. Klein's *Kinematics of Machinery*. Second term (4).

215. Advanced Machine Design. The design of machines in general, with special attention to the calculation and designing of the various parts for strength, stiffness and other requirements. Problems covering such machinery as cranes, hoists, pumps, machine tools, hydraulic machinery, etc. First term (4).

216. Engineering Laboratory. Work of 211 and 213 continued. Test of boilers, of power plants and of pumping stations in the neighborhood. Advanced work along the lines of 214. Text-book: Carpenter & Diedrich's *Experimental Engineering*. Fee, $3.50. First term (1).

217. Engineering Laboratory. A shorter course, selected and condensed from 210, 211, 216, 218 and 221, especially in steam engineering, for students in Metallurgical and Mining and Electrical Engineering. Fee, $3.50. First term (1).

218. Engineering Laboratory. Work of 217 completed, along same lines. Fee, $3.50. Second term (1).

219. Advanced Machine Design. A continuation of course 216, being more specialized. Second term (4).

220. Mechanics of Machinery. The principles involved in the design and construction of machinery such as hoisting-, pumping-, and air-machinery, locomotives, etc. Second term (3).

221. Engineering Laboratory. Work of 217 carried forward, along same lines. Analysis of flue gases; complete tests of the power plants of the vicinity. Text-book: Carpenter & Diedrich's *Experimental Engineering*. Fee, $3.50. Second term (1).

222. Gas Engines. The Mechanics, Thermodynamics, Thermo-Chemistry, Construction, and Tests of the Gas Engine. Text-book and reference book: Streeter's *Internal Combustion Engines*. First term (3).

223. Steam Turbines. The Mechanics, Thermodynamics, Construction and Experimental Results of Stationary and Marine Steam Turbines. Text-book: Moyer's *Steam Turbines*. Second term (4).

224. Mechanical Engineering. One or two of the following subjects: plant engineering, refrigeration, aeronautics, marine engines, etc. Second term (3).

225. Heat Engineering. The laws of gases and the gas cycles; the properties of steam and other vapors, the vapor cycles, entropy and the temperature-entropy diagram; a study of the theory of prime movers and the action of steam in engines and turbines; the use of the steam tables, the Mollier and temperature entropy diagrams. For students in the Course of Ship Construction and Marine Transportation. First term (3).

226. Marine Engines and Turbines. A detailed study of the multiple expansion reciprocating engine, the steam turbine and the Diesel engine. A study of the theory, economy and design of these three prime movers in the class room supplemented by work in the drawing-room and laboratory. For

students in the Course in Ship Construction and Marine Transportation. First term (4).

227. PLANT ENGINEERING. A study of the organization and operation of industrial plants in the vicinity of the University. A course extending throughout the last two terms of the curriculum in Mechanical Engineering and covering a study of plant transportation, conversion, fabrication, power and accessories. Lectures, laboratory work, shop visits, and reports in the form of Mechanical Engineering Seminary. Preparation required, course 210. First and second term (1).

METALLURGY

PROFESSOR RICHARDS, ASSOCIATE PROFESSOR ROUSH, ASSISTANT PROFESSOR BUTTS, ASSISTANT PROFESSOR PULSIFER

242. INTRODUCTORY METALLURGY. A course of lectures on the distribution of the ores, of the various metals, their geographical distribution and conditions of their production; their present economic and mechanical importance. When possible to arrange, visits are made to metallurgical plants, to acquaint the student with the general features of metallurgical apparatus, their appearances and their working. First and second terms (1).

243. PHYSICAL METALLURGY. A general study of the chemical and physical properties of the various metals as related to their commercial applications. First term (1).

244. GENERAL METALLURGY. Metallurgical processes. Principles of combustion. Application of thermo-chemistry. Measurements of high temperatures. Fuels, natural and artificial, solid, liquid and gaseous. Fluxing. Refractory materials. Classification of furnaces. Artificial draft and blast. Electric furnaces. Reference books: Hofman's *General Metallurgy*. Second Edition; Fulton's *Principles of Metallurgy*. Second term (2).

245. METALLURGY OF IRON. Chemical and physical properties of iron. Iron ores. Preparation of ores. The blast furnace. The mixer. Remelting. Refining. Puddling. The Bessemer process. The open hearth process. Duplex process. Cementa-

tion. Manufacture of crucible steel. Electric Steel. Alloy steels. Direct processes. Casting, forging and heat treatment. Reference books. Ledebur's *Eisenhüttenkunde*. Stoughton's *Metallurgy of Iron and Steel*. Second term (2).

246. METALLURGICAL PROBLEMS. A course of problems embodying the use of the physical, chemical and mechanical principles as the basis of practical metallurgy. Data taken from actual practice, so that the results have an important bearing in the understanding of metallurgical processes. References: Richards' *Metallurgical Calculations*, Parts I and II. Second term (1).

247. GENERAL METALLURGY. Shorter course. Reference books: Fulton's *Principles of Metallurgy*, Hofman's *General Metallurgy*. First term (1) or second term (1).

248. METALLURGY OF IRON, STEEL AND OTHER METALS. A shorter course. Reference books: Stoughton's *Metallurgy of Iron and Steel*. Gowland's *Metallurgy of Non-Ferrous Metals*. First term (1) or second term (1).

249. METALLURGICAL PROBLEMS. A course of problems embodying the use of physical, chemical and mechanical principles utilized in practical metallurgy, particular attention being paid to the needs of the civil, mechanical and electrical engineer. Richards' *Metallurgical Calculations*, Parts I and II. First term (1) or second term (1).

Courses 247, 248 and 249 are an abridgement of courses 245, 246, 247 and 251, for students of Civil, Mechanical and Electrical Engineering, Ship Construction and Marine Transportation.

250. MECHANICAL AND HEAT TREATMENT OF STEEL. A brief course in the mechanical working heat treatment and metallography of iron and steel, for students of Mechanical Engineering. First term (3).

251. METALLURGY OF COPPER, LEAD, SILVER, GOLD, ZINC, TIN, MERCURY, NICKEL, ALUMINIUM, ETC. COPPER: Chemical and physical properties. Ores. Smelting sulphide ores. The Bessemer process. Treatment of oxide ores. Wet process. Electrolytic processes. LEAD: Chemical and physical properties. Ores. Smelting processes. Condensation of lead fume. Refining and desilverization of base bullion. SILVER: Chemical and physical properties. Ores. Smelting with lead. Amalgamation. Leaching processes. GOLD: Chemical and physical

properties. Ores. Gold washing. Gold milling. Chlorination. The cyanide process. Parting gold and silver. ZINC: Chemical and physical properties. Ores. Belgian and Silesian processes for the manufacture of spelter. Manufacture of zinc oxide. Electrolytic processes. MERCURY: Chemical and physical properties. Ores. Processes of extraction. ALUMINIUM: Chemical and physical properties. Ores. Extraction by electrolysis. TIN, NICKEL, PLATINUM, ANTIMONY, etc.: Chemical and physical properties; Ores; Processes of Extraction. Reference books: Schnabel's *Handbook of Metallurgy*, Gowland's *Metallurgy of the Non-Ferrous Metals*, Hofman's *Metallurgy of Copper*, Hofman's *Lead*, Collins' *Silver*, Rose's *Gold*, Ingall's *Zinc*, Richard's *Aluminium*, Louis' *Metallurgy of Tin*, Wang's *Antimony*. First term (4). For students of Mining Engineering, first term (3).

252. METALLURGICAL PROBLEMS. A course of problems concerned with the principles utilized in the metallurgy of the non-ferrous metals. Reference: Richards' *Metallurgical Calculations*, Part III. First term (1).

253. ELECTROCHEMISTRY. Lectures discussing the phenomena of electrolysis and the various theories proposed to account for them. Special consideration of secondary reactions, and also of the quantitative relations between electrical and chemical energy, and their mutual convertibility. Reference books: Le Blanc's *Text-book of Electrochemistry*. Allmand's *Applied Electrochemistry*. First term (1).

254. ELECTROMETALLURGY. Lectures discussing the practical application of electricity to metallurgical processes. Electrolytic and electric furnace plants and practise. Reference books: Borcher's *Electric Smelting and Refining*. Neuberger's *Handbuch der Praktischen Elektrometallurgie*. Second term (1).

255. ELECTROCHEMICAL LABORATORY. Quantitative relations in the deposition of metals by electrolysis. Experimental study of the conditions controlling the nature of electrolytic deposits. Electrolysis of fused salts. Cathodic and anodic reactions. Fee, $5. First term (1).

256. METALLURGICAL LABORATORY. Calibration and use of instruments employed in metallurgical investigations, pyrometers, calorimeters, etc. Determination of specific heats, latent heats of fusion and vaporization, vapor tensions, heats of combustion, heats of chemical combination and reaction.

Heat conduction and radiation. Determination of efficiencies of furnaces. Experiments with electrochemical processes, electric furnaces, etc. Fee, $10. Second term (2).

257. Metallography. The study of Metals and Alloys: their physical, chemical and microscopic properties together with deductions drawn therefrom. The influence of thermal and mechanical treatment on physical properties and structure. Lectures and laboratory work. Fee, $10. Reference books: Gulliver's *Metallic Alloys*, Sauveur's *Metallography and Heat Treatment of Iron and Steel.* First term (2); second term (1).

258. Metallurgical Design. The application and extension of the principles involved in courses 247 and 252 to the design of metallurgical apparatus and machinery. Second term (2).

259. Metallurgical French or German. Reading of technical journals or books with the staff of the Department. Second term (1).

260. Seminary. A conference hour of the staff of the Department with students, to discuss current metallurgical processes and problems, and thesis work, involving some reading of current literature and other preparation on the part of the students. First term (1). Second term (1).

261. Thesis for Degree. Presentation by every student in Metallurgy of a thesis on some topic which requires original literary and other work, such as observations, calculations, or experimental tests when practicable. First term (1); second term (3).

For summer schools, see courses 350 and 413, also statement on page 134.

GEOLOGY

PROFESSOR MILLER, ASSISTANT PROFESSOR TURNER, ASSISTANT PROFESSOR FRETZ, MR. LAWALL

266. Mineralogy. The principles of crystallography with practice in the determination of forms on models and crystals. The physical properties, origin, occurrence, association and alteration of minerals. A study of about one hundred and fifty of the common mineral species and varieties, particularly the rock-forming minerals, with practice in identification based on association and physical properties. First term (4).

A deposit of $5 is required from each student taking course 266, to cover damages to collections and instruments and the value of supplies furnished him. In case the damage consists only of ordinary wear and tear the amount retained to cover it is about $3 for each student.

267. Blowpipe Analysis. A course in qualitative blowpipe analysis and special chemical tests in which the chemical and physical behavior of all the common chemical elements and their compounds under various conditions is noted. Methods of rapid qualitative testing as a means of identifying minerals and chemical compounds with the aid of the blowpipe. Fee, $4. First and second terms (1).

268. General Geology. A course in dynamic, structural, and historical geology. Text-book, supplemented by illustrated lectures in which the relation of geology to engineering problems is discussed. The different geologic periods and their characteristic types of life. The principles of organic evolution as shown in the development of new forms in the successive periods are treated; also a brief review of the geology of the North American continent and the physical changes which it has undergone during its development. Second term (2).

269. Geological Laboratory and Field Trips. A study, during the winter months, of the various types of rocks, to enable students to determine and classify them without a microscope. Principles of rock classification presented in a series of lectures, supplemented by laboratory practice with a petrologic collection comprising rocks gathered from all parts of the country. Attention given to the examination of the varieties of rocks used for constructional purposes with discussions of the factors which render them desirable. A series of lectures on primary and secondary rock structures, supplemented by laboratory work on the interpretation and construction of topographic and geologic maps and sections. Field trips weekly, during the spring months, to nearby localities to study rock structures and deposits of economic importance.

The region furnishes excellent examples of varied structures and contains numerous quarries where slate, cement rock, limestone, sandstone, gneiss and serpentine are obtained, all of which are visited by the classes. On such field

trips, special attention is given to the methods of geologic mapping. Second term (3), (2) or (1).

A fee of $1 is required of each student taking course 269 to cover damage to collections and the value of supplies furnished.

270. Economic Geology. A study of the origin, modes of occurrence, properties, sources, production, and uses of the nonmetallic mineral products. Comprehensive reports on various products. Preparation required: 266, 268 and 269. First term (2).

271. Economic Geology. A study of the metallic mineral products. Causes of the formation of cavities in rocks, their relation to metalliferous deposits; discussion of the theories of ore-deposition; the structure, geologic horizon, and geographic distribution of the principal metallic economic deposits of the United States. Recitations, illustrated lectures, field trips, and laboratory work. Visits, for the purpose of studying ore occurrence, to the zinc mines of Franklin Furnace, N. J., and Friedensville, Pa., the magnetic mines of Dover, N. J., and Cornwall, Pa., the limonite mines of Ironton, Pa., and the anthracite coal mines. Preparation by each student of a series of maps illustrating the location, production, chemistry, and geology of the economic products of the United States. Preparation required: 266, 268 and 269. Second term (4).

272. Paleontology. An elementary course in paleontology in which the animal life of the past is considered both from the biological and geological viewpoints. Theories of origin and evolution of life; principles of stratigraphy and paleontology. Study in the laboratory of index fossils of the successive geologic periods. Preparation required: 268 and 269. Second term (3).

273. Geology of North America. The geological age and geographical distribution of the rocks of which North America is composed; the structure and history of its mountain ranges; the history of its geological development and origin; reviews of the great surveys that have been made. Lectures and laboratory work. Preparation required: 268 and 269. Second term (3).

274. Physiography. The cosmic relations of the earth; the classification of land forms; the study of their origin, growth, and decay and the factors governing their development. Study

of topographic and geologic maps. The relation of topography to geologic structure. The response of man and other organic life to an inorganic environment with special reference to the influence of physiography upon the economic development of countries. Brief study of weather and climate. Second term (2).

275. Field Geology. Geological maps—their use and the methods by which they are constructed. Practice in the actual working out of surface geology. Problems in plotting geology on topographic maps, each student being assigned a definite area and required to make a geological map of it with structure sections. Collection by each student of a full set of specimens to illustrate the geology.

The first part of the course is devoted exclusively to field work and the notes then taken are worked up in the laboratory when the weather prevents further out-door work. Preparation required: 268 and 269. First term (3).

A fee of $1 is charged each student taking this course.

276. Petrography. The optical properties of minerals and their study with the petrographic microscope. Petrography of the more important igneous rocks. Lectures, recitations and laboratory work. Preparation required: 266 and 325. First term (2).

A laboratory fee of $3 is charged each student taking this course.

277. Physiography. A study of topographic forms and the processes that have produced them; the weather and climate; and the influence of physical conditions upon the development of countries. First term (3).

278. Physiography. A continuation of course 277. Recitations, lectures, laboratory work, and field trips. Physiographic regions of North America and Europe. Topographic maps and the preparation of weather and climate charts. Emphasis on the effect that physiographic conditions have in determining the commercial and industrial importance of nations. Second term (3).

279. Mining and Geologic Law. A study of the legal matters that confront a mining geologist. The law in regard to underground waters and mineral products. Preparation of abstracts of important cases, accompanied by drawings showing the

geologic conditions upon which the decisions were made. First term (1).

280. Structural Geology. The study of special features of structural geology in the field and laboratory. First term (1).

281. Geologic Methods. The study of methods employed by the geologist in the various lines of geologic investigation. Methods employed by the United States Geological Survey and by the mining companies that employ geologists. Special attention to the problems that confront an economic geologist in the investigation of coal lands, oil properties, metal mines, etc. Second term (3).

BIOLOGY

PROFESSOR HALL, MR. FLORY

290. Botany. An elementary course treating of the structure and classification of plants. Lectures, laboratory work, and reference to text-books. Preparation advantageous: 292. Second term (2).

291. Forestry. Lectures, recitations and laboratory work. A brief introduction to botany, followed by lectures on dendrology and text-book work an forestry. Laboratory work devoted mainly to dendrology and the characteristics of the wood of important timber species. Field trips during the autumn to enable the student to become familiar with the trees of the region. First term (3).

Careful consideration has been given by friends of the University and by the Board of Trustees to the matter of forestry in connection with the conservation of our natural resources. It does not appear to the Trustees that the present demand for professional foresters is such as to justify the establishment of a school of forestry at the University. It does appear that the question is of such great and growing importance that the University should do its part toward calling the attention not only of its students but of the section of country reached by the influence of the University to the need of a better knowledge of the principles involved. To this end courses of lectures have been instituted to which the public is invited and special instruction is given in forestry in certain of the courses.

In furtherance and support of the cause of Forestry the University has offered free tuition scholarships to graduates

of the Pennsylvania State School of Forestry at Mont Alto, to pursue, as special students at this University, courses supplementary and cognate to their studies at Mont Alto.

292. Biology. Lectures, recitations, and laboratory work. Lectures on the following topics: (*a*) fundamental conceptions; life, protoplasm, the cell, etc.; (*b*) the structure, development, relationships, habits, and geographic distribution of animals; (*c*) the more important biological theories; variation, heredity, evolution, etc. In the laboratory, types of the various phyla are dissected and drawings made. First term (3).

293. Comparative Anatomy of Vertebrates. Text-book work and recitations on the comparative anatomy of vertebrates, with a more extended discussion of biological theories. Laboratory work consisting of the dissection of types of the several vertebrate classes. Preparation required: 292. Second term (3).

294. Vertebrate Embryology. Lectures, reading and laboratory work. Study of living, preserved, and sectioned material demonstrating the successive stages of cleavage, gastrulation, and the formation of organs. Preparation required: 293. First term (3).

295. Sanitary Biology. Lectures, recitations, assigned reading and laboratory work. Study of bacteria; microscopical appearance, methods of staining, plate and tube culture, etc. The quantitative and qualitative bacteriological and microscopical examination of water. Second term (3).

296. Bacteriology. Recitations and laboratory work. General study of bacteria. Special attention to those forms which are economically important, such as those of water, foods, dairy products, soils, etc. Preparation advantageous: 290 or 292. First term (2).

297. Advanced Bacteriology. Lectures and recitations on the study of disease, immunity and sanitation. Laboratory work on the determination of species, with a special study of the pathogenic bacteria. Opportunity is given for the independent study of special problems in practical hygiene. Preparation required: 295 or 296. Second term (2). (Not offered in 1920-21.)

298. Physiology. A course in normal physiology, hygiene and sanitation aiming to give that knowledge of the body and its functions which all should have. Emphasis on the applica-

tion of such knowledge to personal hygiene and public sanitation. Second term (2).

(A fee of $3 is required in courses 292, 295, 296, and 297, to cover the cost of material and breakage.)

HYGIENE

DR. ESTES

299. Hygiene. Lectures on methods of personal hygiene and sanitary laws. For the benefit of engineering students who may later, as engineers and explorers, be charged with the health oversight of men, suggestions are given in this course regarding the physical care and sanitary comfort of working groups.

MINING ENGINEERING

PROFESSOR ECKFELDT, ASSISTANT PROFESSOR BARTLETT, MR. LARSON

300. Mechanical Drawing. The use of instruments. Lettering and tracing. Isometric drawing. Sketches and working drawings of simple machine parts. Blue printing. Descriptive Geometry. Projections, intersections, and developments of cylinders, prisms, cones, etc. Application to graphical solution of mining problems. First and second terms (2).

301. Mining Engineering. Prospecting. Modes of occurrence of minerals. Uses of geology. Prospecting for placers, veins and beds. Magnetic prospecting. Drilling, sampling. Valuation of property. Location of claims. Patenting mining ground. Boring. Use of bore-holes. Methods; by percussion and rotation. Special methods. Shaft sinking by boring. Survey of bore-holes. Exploitation. Location of plant. Rock drilling; tools and machines. Explosives; blasting; safety regulations. Shaft and slope sinking; tunneling. Supporting excavations by timber, metal, masonry, or concrete. Systems of mining underground and at the surface. Haulage. Surface and underground methods. Motors and cars; wire rope, aerial tramways. Loading and unloading, storage of minerals. Transportation of workmen. Signaling. First term (4).

302. Ore Dressing. General principles and physical properties upon which the recovery of minerals or metals from ores are based, followed by detailed study of machines and

apparatus used in modern practice for coarse and fine crushing; classifying and preparation for concentration; various methods of concentration, including gravity and magnetic methods, oil flotation, etc.

Application of above methods to various ores; mill schemes or flowsheets. Study of procedure followed for treatment of ores and coal in typical modern concentrating plants.

Mill location, construction, arrangement of machinery, operation, and costs. Visits to mills and anthracite breakers.

ORE DRESSING LABORATORY. Experimental work and tests on ores, giving practical application of principles and processes covered. A well equipped modern laboratory gives opportunity for individual as well as class operation of the most approved machinery for the preparation of ores. Fee, $5. First term (3).

303. MINING ENGINEERING. HOISTING. Motors, ropes, attachments, receptacles. Safety appliances. Systems of hoisting. DRAINAGE. Surface water; prevention of access. Mine dams. Tunnel drainage. Mechanical drainage; water hoisting; pumping. Classes of pumps. VENTILATION. Atmosphere of mines. Pollution of air. Natural and mechanical methods of ventilation; systems. Types and efficiencies of ventilating machines. Instruments for testing air. Ventilation laws. LIGHTING. Methods employed. Safety lamps; electric lighting. Safety regulations. FIRST AID. Accidents; classes, causes. Means of prevention. Rescue work. Hygiene of mines; rules and laws. First Aid to injured. RAILROAD CONSTRUCTION. Earthwork, trackwork, trestles, bridges, railroad structures, water tanks, yards. Second term (4).

304. MINE SURVEYING. Instruments. Forms of notes. Outside work. Determination of meridian. Inside work. Connecting outside and inside work through shafts, slopes, or tunnels. Calculation of notes; mapping. RAILROAD SURVEYING. Preliminary and location methods; theory of curves, turnouts, etc. Care of maps. Detection of errors. Special problems. Fee, $1. Summer term at the end of Junior year, four weeks, beginning June 15, 1921.

305. MINING ENGINEERING. CONSTRUCTION MATERIALS. The use of stone, brick, concrete, metal and wood for foundations, piling, dams, reservoirs, retaining walls, mine buildings, railroads, trestles, tipples, ore bins and docks. MINE ADMINIS-

TRATION. Organization, employment of labor, management, mine accounts, principles of mining. First term (3).

306. OIL AND GAS TECHNOLOGY. Origin and distribution of petroleum and natural gas. General survey of the geological conditions surrounding their accumulation. Oil shales. Prospecting and mapping. Location of wells. Drilling; pumping. Special methods. Storage. Pipe lines. Tank cars. Second term (2).

307. MINING DESIGN. The design of parts of mining plant to meet given conditions, with detailed working drawings, accompanied by estimates of material and costs. Second term (3).

308. PROSPECTING. Surface indications of minerals, including oil, gas and water. Geological interpretation of strata and out-crops. Prospecting on surface and underground. Boring; magnetic prospecting. Mapping. Sampling and valuation of prospects. Locating and patenting claims. This course is given as an elective for B.A. students. First term (2).

PHYSICS

PROFESSOR MAC NUTT, ASSOCIATE PROFESSOR CHARLES, ASSISTANT PROFESSOR FRY, ASSISTANT PROFESSOR FRAIM, MR. MARTIN, MR. TAYLOR, MR. CONCILIO, MR. NICHOLAS, MR. ZINSZER

320. ELEMENTARY MECHANICS. Statics. Lecture demonstrations and recitations. First term (3).

321. ELEMENTARY MECHANICS. Dynamics. Heat. Lecture demonstrations and recitations. Second term (3).

322. PHYSICAL MEASUREMENTS. Laboratory and lectures. Second term (1).

323. ELEMENTARY PHYSICS. Electricity and magnetism. Lecture demonstrations and recitations. First term (3).

324. PHYSICAL LABORATORY. Mechanics, heat and electricity. Pre-requisite, course 322. First term (1).

325. ELEMENTARY PHYSICS. Light and sound. Lecture demonstrations and recitations. Second term (3).

326. PHYSICAL LABORATORY. Electricity, magnetism, light and sound. Pre-requisites, courses 322, 323, 324. Second term (1).

327. ELEMENTARY PHYSICS. A brief general course. Lecture demonstrations, recitations and laboratory. First term (3). Second term (3).

328. Advanced Theory of Electricity and Magnetism. Lectures and recitations. Ferro-magnetism, electro-magnetism, induced electromotive force and inductance, magnetic properties of iron, electric charge and the condenser, electric field, potential, electric oscillation and waves, electron theory, electrolysis. Pre-requisites, differential and integral calculus and course 323. First term (2).

329. Electrical Laboratory. Precise measurements. Pre-requisites, courses 322, 323, 324, 326. First term (1).

330. Electrical Laboratory. Precise measurements. (Continuation of 329.) Second term (1).

331. Electrical Laboratory. Advanced experimental studies and tests. (Continuation of 330.) First term (1).

332. Theoretical Physics. Elective courses in the theory of heat, in the theory of electricity and magnetism, and in the theory of optics. Arrangements as to topic and as to time to be devoted to it are made for each group of students who elect Theoretical Physics. First and second terms (3) to (5).

333. Physical Research. Experimental investigations in physics to be elected by special advanced students. Arrangements as to topic and as to time to be devoted to it are made for each individual student. First or second term (2) to (4).

334. Photometry and Illumination. Lectures and recitations. Illumination standards, measurements of light and of illumination, laboratory methods and devices, commercial methods and experiments, comparison of illuminants and illuminating devices, practical installations. First term (1).

335. General Physics. A course intended primarly for students taking pre-medical studies. Pre-requisite, course 327. First term (3); second term (3).

336. The Teaching of Physics in Secondary Schools. Principles of scientific method. A study of class room practise in neighboring schools. Text-books and methods. First term (2).

Fee of $6 required in connection with courses 322, 324, 326, 329, 330, 331 and 333.

ELECTRICAL ENGINEERING

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT, ASSOCIATE PROFESSOR SCHEALER, ASSISTANT PROFESSOR BEAVER, ASSISTANT PROFESSOR GRUBER, ASSISTANT PROFESSOR ESHBACH

350. CONSTRUCTIVE ELEMENTS OF ELECTRICAL APPARATUS. Studies of electrical machinery and appliances with the object of familiarizing the student with principles of operation, structural details, and practical uses. The student is supplied with a complete printed outline of the work to be done containing full instructions and explanations. The work consists of three parts, as follows: (*a*) Illustrated lectures, (*b*) inspection and sketching of electrical machines and apparatus, and (*c*) visits of inspection to neighboring electric light and power plants. Written reports are required on each day's work. Fee, $3. This work is accompanied by Constructive Elements of Machinery, No. 201. Summer term, four weeks, beginning June 15, 1921.

351. ELECTRICAL DISTRIBUTION. Systems of direct current distribution; wiring formulas and applications; installation of electrical machinery and apparatus; interior wiring, overhead and underground construction; rules and regulations of the National Board of Fire Underwriters. Preparation required: 350. First term (2).

352. DYNAMOS AND MOTORS. Review of principles of electricity and magnetism with special reference to their application to the dynamo. The construction, operation and control of direct current machinery; practical operation and management of dynamo machines; station equipment; cost of electrical energy; electro-magnets, magnetism of iron; characteristic curves, armature windings. Illustrative problems. Preparation required: 322, 351. Second term (3).

353. DYNAMO LABORATORY. Introductory course supplementing the class work of 352. Experimental studies and tests of direct current generators, motors, and applicances, for characteristics, regulation, efficiency, insulation, etc. Fee, $6. Preparation required: 322, 351. Second term (1).

354. DYNAMOS AND MOTORS. An abbreviated course adapted to those students who do not continue this subject in the following year; the principles and practice of direct current engineering, including: the elementary theory, construction, opera-

tion and control of direct current generators and motors, electromagnets, solenoids, automatic starters and controllers, station equipment, storage batteries. Illustrative problems. Preparation required: 332, 324. First term (2).

355. Dynamo Laboratory. Introductory course supplementing the class work of 354. Experimental studies and tests of direct current generators and motors for characteristics, regulation, efficiency, etc. Fee, $6. Preparation required: 323. First and second terms (1).

356. Dynamo Laboratory. Continuation of 355 and supplementing the class work of 362 or 379. Advanced testing of direct current machines; practice in operating and testing alternating current apparatus. Fee, $6. Preparation required: 355, 354. Second term (1).

357. Theory of Alternating Currents. The elementary principles of alternating currents. Lectures, recitations and problem work. Preparation required: 352, 326. First term (3).

358. Dynamo Laboratory. Continuation of 353. Advanced testing of direct current machines. Fee, $6. Preparation required: 352, 353. First term (1).

359. Theory of Alternating Currents. Continuation of 357. Advanced theoretical studies of alternators, synchronous motors, and synchronous converters. Preparation required: 357. Second term (2).

360. Electrical Engineering. Application of physical and mathematical principles to the analysis and solution of problems relating to direct and alternating current circuits and apparatus; transient phenomena, use of complex quantities; non-harmonic periodic wave forms. Preparation required: 328, 357. Second term (2).

361. Electrical Engineering. A course particularly adapted to students who do not further specialize along electrical lines; systems of generation, transformation, distribution and transmission of electrical energy by direct and alternating currents; the application of electric motors to various industries; overhead and underground construction; estimates and costs. Preparation required: 354, 355. Second term (2).

362. Dynamo Laboratory. Continuation of 358. Advanced testing of direct current machines. Alternating current test-

ing begun. Fee, $6. Preparation required: 357, 358. Second term (1).

363. Alternating Current Machinery. Study of the structural details, characteristics and operation of alternators, alternating current motors, rotary converters and transformers; application of vectors. Preparation required: 329, 359, 360. First term (4).

364. Dynamo Testing. Lectures on the methods of testing electrical machinery and apparatus, including direct current generators, motors and motor generator sets. Special methods of testing large machines; commercial tests as carried out by the large manufacturing companies. Preparation required: 328, 357, 358. Second term (1).

365. Dynamo Testing. Continuation of 364. Lectures on testing of alternating current machinery and apparatus, including generators, motors, rotary converters, transformers, induction regulators, etc. Preparation required: 359, 364. First term (1).

366. Dynamo Laboratory. Advanced experimental studies and tests of direct and alternating current generators and motors, synchronous converters, transformers and auxiliary apparatus; measurement of power in polyphase circuits. Fee, $12. Preparation required: 359, 360, 362. First term (3).

367. Electrical Design. Application of electric, magnetic and mechanical prinicples to the design of electromagnetic mechanisms, direct current generators and motors; predetermination of characteristics and performance; armature windings. Lectures, recitations, problems, drafting. Preparation required: 359, 360, 362. First term (3).

368. Electric Stations. Consideration of prime movers; generating machinery, discussion of types and operation; auxilliary machinery and transformers; storage batteries and their application; switch-boards, measuring and protective devices; design and arrangement; station characteristics; substations; operation and management; visits to neighboring plants. Preparation required: 355 or 356, 360 or 361. First term (2).

369. Electrical Engineering Seminary. A weekly meeting held in the department reading room for discussion of topics from the current journals of theoretical and applied elec-

tricity. Presentation of papers on assigned topics; new inventions and discoveries critically reviewed. Preparation required: 357, 360. First term (1).

370. Electrical Design. Continuation of 367. Application of electric, magnetic and mechanical principles to the design of alternating current machinery and apparatus; predetermination of characteristics and performance; armature windings. Lectures, recitations, problems, drafting. Preparation required: 363, 366, 367. Second term (2).

371. Electrical Traction. The construction, equipment and operation of different types of electric railways. The application of electric traction under steam railroad conditions; the dynamics of electric train movements; predeterminations of speed-time curves and the power required for different types of runs. Choice of car equipment; cost of construction and of operation. Testing of railway systems. Visits of inspection to power plants and required reports. Preparation required: 363, 368. Second term (3).

372. Electric Power Transmission. The long distance transmission of power by electricity for use in lighting, traction, mining and manufacturing work. Mathematical determination of line constants, regulation, interference, transients, etc. Switching and protection of circuits; metering and methods of charging for power; recent practice in design and construction of lines and systems. Preparation required: 357 or 363, 360 or 361, 363. Second term (3).

373. Electrical Engineering Seminary. Continuation of 369. Presentation and discussion of reports on thesis work. Preparation required: 369. Second term (1).

374. Dynamo Laboratory. Continuation of 368. Advanced alternating current testing. Fee, $12. Preparation required: 363, 364, 366. Second term (2).

375. Alternating Currents. A course following course 354; the principles and practice of alternating current engineering; the theory of alternating currents with applications to alternating current generators, motors, transformers and other apparatus; systems of transmission and distribution; electric lighting. Preparation required: 354. First and second terms (2).

376. Inspection Report. During the vacation between the Junior and Senior years each student in Electrical Engineer-

ing is required to inspect some electric railway system, lighting or power plant, or other electrical installation, and prepare a written report thereon. A descriptive outline of the installation which the student proposes to inspect must be submitted to the Professor of Electrical Engineering before July 6th, and after approval the detailed report must be handed in before September 21st. These reports should contain such calculations, photographs, drawings and plots as each individual case may require.

377. Thesis. Until this year each candidate for the degree of Electrical Engineer was required to present a thesis upon a subject chosen by the candidate during the first term of the Senior year. At present the thesis is not required, but the candidate is allowed the choice between preparing a thesis and taking course 378 in Electrical Communication. The work upon which the thesis is based is done during the second term. It consists in part of reading from references, and in part of independent work in theory, experimental research or designing. Reports of progress in thesis work are required from time to time during the term. Second term (3).

378. Electrical Communication. A survey of the methods of electrical communication, principles of various systems of wire telegraphy, wire telephony, radio telegraphy and telephony, radio laboratory measurements, radio practice of the U. S. Signal Corps. Preparation required: 357 or 375. Second term (3).

A fee of $6 for each term-hour (period) of dynamo laboratory work taken per term is required of each student.

For Summer Schools, see courses 201, 350, 206, and 375, also statement on page 134.

CHEMISTRY

PROFESSOR ULLMANN, ASSOCIATE PROFESSOR BABASINIAN, ASSOCIATE PROFESSOR DIEFENDERFER, ASSOCIATE PROFESSOR CHAMBERLIN, ASSOCIATE PROFESSOR LONG, ASSOCIATE PROFESSOR COBB, ASSISTANT PROFESSOR BECK, ASSISTANT PROFESSOR EWING, MR. CARTER, MR. ANDERSON, MR. BUCKLEY, MR. SMULL, MR. WARD, MR. EARLY, MR. BARBEHENN

390. ELEMENTARY CHEMISTRY. Description of the non-metallic and metallic elements and their compounds. Lectures illustrated by experiments, diagrams, working drawings and specimens from the museum. Note-books on the lectures required. Text-book: Kahlenberg's *Outlines of Chemistry*. First term (2).

391. CHEMISTRY LABORATORY. Experiments covering a systematic study of the chemical and physical properties of the more important elements and their compounds. Text-book: Long and Chamberlin's *Experimental General Chemistry*. First term (2).

392. CHEMISTRY LABORATORY. For B.A. students. Shorter course than course 391. First term (1).

393. CHEMISTRY. A course for students who pass the examination in Elementary Chemistry held on the first Saturday of the term. Text-book: Smith's *General Chemistry for Colleges*. First term (2).

394. CHEMISTRY. Continuation of 390 and 393. Second term (1).

395. QUALITATIVE ANALYSIS. Practical work in the qualitative laboratory, accompanied by lectures and recitations. Text-book: Treadwell's *Analytical Chemistry*. Vol. I. Second term (3).

396. QUALITATIVE ANALYSIS CONFERENCE. Special consideration of science underlying qualitative analysis. Second term (1).

397. STOICHIOMETRY. Chemical problems and reactions. Text-book: Long and Salisbury's *Chemical Calculations*. Second term (1).

398. CHEMICAL PHILOSOPHY. Lecture Course, with recitations. Theories of chemistry; physical and chemical methods of determining atomic and molecular weights, thermo-chem-

istry, dissociation, solutions, catalysis, electrolysis, radioactivity, non-metallic elements and their compounds. Prerequisite: courses 390 or 393, 391, 397. Text-book: Mellor's *Modern Inorganic Chemistry*. First term (3).

399. Advanced Chemistry. Lecture course, with recitations. Phase rule, solid solutions, colloid chemistry, metallic elements and their compounds. Prerequisite: course 398. Text-books: Mellor's *Modern Inorganic Chemistry*, Gulliver's *Metallic Alloys*. Second term (3).

400. Quantitative Analysis. Practical work in the quantitative laboratory, accompanied by lectures and recitations. Acidimetry, alkalimetry, chlorimetry, and the determination and analysis of simple chemical compounds and ores. Text-book: Treadwell's *Analytical Chemistry*, Vol. II. First term (3).

401. Quantitative Analysis. Shorter course. Practical work in the quantitative laboratory. Analysis of simple chemical compounds, ores and metallurgical products. First term (3).

402. Quantitative Analysis Conference. Lecture and recitations concerning the laboratory work of Courses 400 and 401. First term (1).

403. Quantitative Analysis. Continuation of Course 401. Second term (3).

404. Quantitative Analysis. Continuation of Course 400. Analysis of minerals, ores, slags, alloys, electrolytic analysis, etc. Text-book: Treadwell's *Analytical Chemistry*, Vol. II. Second term (4).

405. Quantitative Analysis Conference. Lectures and recitations concerning laboratory work of Courses 401 and 400. Second term (2) or (1).

406. Quantitative Analysis. Continuation of Course 401. Ores and alloys, complete analysis of iron and steel; also gas analysis, mineral water analysis, etc. Text-books: Treadwell's *Analytical Chemistry*, Vol. II, Lord and Demorest's *Notes on Metallurgical Analysis*, Hempel's *Gas Analysis*. First term (2).

407. Quantitative Analysis Conference. Discussions concerning the laboratory work of course 406. First term (2).

408. Organic Chemistry. Lectures and recitations. Typical compounds of carbon, their classification, general relations,

and methods of preparation of important compounds. Text-book: Bernthsen's *Organic Chemistry.* translated by Sudborough. First term (3).

409. Organic Chemistry. Laboratory work. Determinations of specific gravities, melting points, boiling points, vapor densities; qualitative and quantitative determinations of carbon, hydrogen, nitrogen, and the halogens. The preparation of pure organic compounds. Text-books: Gattermann-Schober's *Practical Methods of Organic Chemistry*, Cohen's *Practical Organic Chemistry.* First term (2).

410. Organic Chemistry. Continuation of course 408. Lectures and recitations. Second term (4).

411. Organic Chemistry. Laboratory work. Continuation of course 409. Practical methods of saturation, nitration, reduction, diazotisation, sulphonation, etc. Preparation of pure compounds. Study of the properties of dyes and other commercial products. Text-book's: Gattermann-Schober's *Practical Methods of Organic Chemistry*, Cohen's *Practical Organic Chemistry.* Second term (4), (3) or (2).

412. Industrial Chemistry. Engineering fundamentals, including machinery and materials of chemical plants, transportation of gases, liquids and solids, grinding, pulverizing, screening, filtration, evaporation, distillation, etc. Laboratory work includes the application of these fundamentals, with reports on various problems of chemical engineering. First term (3).

413. Assaying. Lectures and laboratory practice in the furnace assay of the ores of lead, tin, gold, silver and of gold and silver bullion. Cyanidization. Calculations for slag and slag mixtures. Text-book: Lodge's *Notes on Assaying.* Summer term: four weeks.

414. Assaying and Industrial Mineralogy. This covers much of the ground of course 413. In addition there is instruction and laboratory work in Industrial Mineralogy, embracing about 75 minerals and rocks. It is intended primarily for students in Chemical Engineering. Summer term, five weeks, beginning June 15, 1921.

415. Industrial Chemistry. Continuation of 412. Lectures, problems and inspection trips on chemical processes and industries. Second term (3).

416. Industrial Analysis. Analysis of commercial products. Laboratory work. Text-book: Allen's *Commercial Organic Chemistry.* Second term (3).

417. Industrial Analysis Conference. Lectures concerning the laboratory work of Course 413. Second term (1).

418. Sanitary Chemistry Laboratory. Qualitative and quantitative examination of drinking water and food-stuffs. Second term (2).

419. Physical Chemistry. Lectures and recitations. Text-book: Lewis' *A System of Physical Chemistry.* First term (3).

420. Physical Chemistry Laboratory. Physico-chemical measurements. Text-book: Findlay's *Practical Physical Chemistry.* First term (1).

421. Physical Chemistry. Continuation of 419. Second term (2).

422. Physical Chemistry Laboratory. Continuation of 419. Second term (1).

423. Research Chemistry Laboratory. Investigation approved by the Professor of Chemistry of some novel problem, involving exhaustive laboratory and library study. Second term (2).

424. History of Chemistry. Chronological development of the science, with assigned reading. Second term (1).

Deposits to cover breakage, chemicals, etc., are required as follows: Ten dollars each in courses 416 and 420; fifteen dollars in courses 391, 392, 418 and 423; twenty dollars in course 409; twenty-five dollars in courses 395, 401, 406 and 412; thirty dollars each in courses 400, 403, 404, 413 and 414; forty dollars in course 411. The unused portion of the deposit is returned to the student.

Summer Schools. Courses in Qualitative Analysis and Stoichiometry begin July 13, 1921, and continue four weeks. The course in Quantitative Analysis begins on the same date and continues for five weeks. The required course in Assaying and Industrial Mineralogy (414) begins June 15, 1921, and a second course may be given later. They are open to all persons prepared to take them.

SHIP CONSTRUCTION AND MARINE TRANSPORTATION

PROFESSOR FOGG, PROFESSOR CHAPMAN,
ASSISTANT PROFESSOR BECKER

450. SHIP CONSTRUCTION. One recitation and two drawing periods a week. A study of the construction of modern steel ships. The class-room work is paralleled by drawing-room exercises where the student works up a number of construction drawings based on the rules of the Registration Societies. Full treatment is given to both longitudinal and transverse types of construction. First term (3).

451. SHIP CONSTRUCTION. A continuation of course 450, which takes up details of ship construction, bow and stern construction, and special types of construction. During the courses 450 and 451 the student fairs a set of ship's lines and cuts a model. Second term (2).

452. NAVAL ARCHITECTURE. Displacement, stability, trim and launching. The class-room work is paralleled by calculations in the drawing room. A displacement sheet is worked up, a curve of stability calculated by the use of the integrator, and launching calculations carried out. Second term (2).

453. NAVAL ARCHITECTURE. Resistance, powering and propulsion of ships. The major part of this course is devoted to the speed and power of ships: the effect of size form and coefficients on speed; appendage resistance; models and model tanks. The use of model tank and trial data for the powering of ships is given full treatment. A study is made of propellers and the influence of the hull on the action of the propeller. Preparation required: 452. First term (3).

454. NAVAL ARCHITECTURE. Strength of ships, steering and maneuvering, freeboard and subdivision. A rigid treatment is given to the longitudinal stresses acting on a ship in a seaway and is paralleled by calculations of longitudinal strength in the course in ship design. The legal requirements of freeboard and bulkhead subdivisions are taken up in some detail and the class-room work is applied to the problem in the course in ship design. Preparation required: 453. First term (2).

455. MARINE ENGINEERING. The marine power plant and the layout of machinery on shipboard. Boilers, reciprocating steam engines, turbines, combination machinery and Diesel engines; fuels, combustion, draft and draft apparatus; con-

densing apparatus and ship auxiliaries. Preparation required: 225. Second term (3).

456. Structural Steel Design. A study of the stresses acting on steel structures, with special attention to the local stresses in a ship's structure; the design of cranes, warehouses and other steel structures. Solution of problems by graphic methods. Preparation required: 167. First term (4).

457. Ship Design. Lectures and drawing-room work. In this course and course 458 each student carries through a design for assigned requirements which parallels the classroom work. In this design he works up the dimensions, coefficients, displacement, estimated weights and lines; stability under various conditions of loading; power and propeller requirements; freeboard and bulkhead subdivisions as required by law; strength calculation; and cargo handling arrangements. The lectures also cover the design of boats for inland water navigation. Preparation required: 450, 453, 455. First term (3).

458. Ship Design. A completion of the work of course 457. The lectures in this course also cover the principles of heating, ventilation and refrigeration and some of the economic aspects of ship design and operation. Preparation required: 457. Second term (4).

459. Shipyard Plants and Terminal Facilities. A study of the methods of constructing ships; shipyard layouts and management. This is followed by a study of the loading and unloading of ships, cranes, piers, transit sheds, warehouses and railroad facilities and the other factors involving a quick "turn around" of a ship in port. Lectures, conferences and inspection trips. Second term (3).

SUMMER WORK IN SHIP CONSTRUCTION AND MARINE TRANSPORTATION

During the summer following the Sophomore and Junior years students are required to spend at least eight weeks in a shipyard or at sea.

MILITARY SCIENCE AND TACTICS

PROFESSOR LANG, ASSISTANT PROFESSOR SHAMOTULSKI, LIEUTENANT GRAHAM

A unit of the Reserve Officers' Training Corps was established at Lehigh University in September, 1919, under the pro-

visions of General Orders No. 49 and Special Regulations No. 44 of the War Department. Conducted on a voluntary basis during the year 1919-1920, the unit had a membership of more than 300 students and the work was highly successful. The Trustees and Faculty of the University, being convinced of the educational value of military training, made military science and tactics a required subject, under the R. O. T. C. regulations, for Freshmen physically fit entering in September, 1920, and thereafter. Provision for this training is made in their schedules of study.

The enrollment in the unit for 1920-1921 is 587. Instruction is given by three Army officers and three sergeants detailed by the War Department.

The military courses contemplated under the War Department regulations consist of two years of basic work and two years of elective advanced work along specialized lines. A student taking the courses for four years becomes eligible, upon graduation, for a commission in the Officers' Reserve Corps of the United States Army.

470. Basic Course. Fundamental military training common to all arms of the service. Three hours a week, two theoretical and one practical. Theoretical instruction consists of lectures, recitations, and quizes on organization, military courtesy and discipline, infantry drill regulations, care and handling of arms and equipment, small arms firing, interior guard duty, sanitation, first aid, personal and general hygiene, minor tactics, morale, and physical training. Practical instruction given in infantry drill, bayonet exercises, target practice, physical drill, ceremonies, and field problems in minor tactics. First and second terms (2½).

471. Basic Course. Second year. Three hours a week fundamental military training common to all arms and liaison, sketching, map reading, signaling. Fundamentals of leadership, automatic rifle, machine guns, minor tactics. First and second terms (2½).

472. Infantry Special. Third year. Five hours a week. Drill, hand and rifle grenades, 37 m/m guns, light (Stokes) mortars, marches, care and handling of equipment, small arms firing, gallery practice, coaching, automatic rifles, rifle grenades, bridge construction, explosives and demolitions, concealment and camouflage, trenches, obstacles, orders and

messages, military courtesy and discipline, minor tactics, map manoeuvers, tactical walks, war game, administration. First and second terms (4½).

473. INFANTRY SPECIAL. Fourth year. Five hours a week. Infantry drill, military history and policy of the United States military law and rules of land warfare, minor tactics, map manoeuvers, tactical walks, war game, administration, musketry. First and second terms (4½).

PHYSICAL EDUCATION

PROFESSOR REITER, MR. BARTLETT, MR. KANALY

The aim of the Department of Physical Education is to insure the health and physical development of every student of the University. Exceptional facilities for accomplishing this aim are afforded in Taylor Gymnasium, field house and the two playing levels of Taylor Field.

Each student, upon entering the University, is given a physical examination by the Department and also a medical examination by the consulting physician. He receives a plotted card showing his relation to the normal student and he is advised as to postural and physical defects. A second physical examination later is offered, to afford evidence of improved condition.

All students are required to take regular exercise under Department supervision. This requirement calls for two hours a week in the gymnasium, or participation, under the oversight of the Director, in one of the following organized sports: football, basketball, wrestling, swimming, soccer, lacrosse, tennis and baseball. Members of the R. O. T. C. unit may substitute one hour of military drill for one of the two hours of required gymnasium.

500. GYMNASIUM. Class exercises in the open air, consisting of setting-up work for correct carriage. Work with dumb bells, wands, and Indian clubs to stimulate circulation, respiration, muscular action and to produce co-ordination and grace. Squad work on the heavy apparatus to develop strength in the larger muscles; recreative work in games and competitive exercises, to develop the play and combative elements. Stress is laid upon athletic dancing. The various drills and athletic dances are accompanied by music. Instruction is given in boxing, wrestling and swimming. The swimming course includes the various swimming strokes,

fancy diving and modern methods of life saving. A competent instructor is in charge. The measure of proficiency required of every student is swimming at least the length of the pool. Classes in the modern dances are held twice a week during part of the winter. There are voluntary classes in advanced apparatus work. Talks are given to the Freshmen on personal hygiene and the physiology of exercise. First and second terms; for Freshmen, Sophomores, Juniors, Seniors, Graduate Students, (1).

501. First Aid to the Injured. A course designed to give the student a practical knowledge of the most efficient methods of giving first aid to the injured. A brief resume of the important points in anatomy, followed by consideration of shock, dislocation, fractures, rabies, hemorrhage, burns, sunstroke, frost bite, electricity and lightning stroke, poisons and their antidotes, drowning, asphyxiation, railroad and mining injuries. Students are required to do practical work in bandaging, applying splints and tourniquets, and to become familiar with the ordinary first aid materials and methods of transporting the injured. Second term (1).

CONFERENCE DEPARTMENT

PROFESSOR LAMBERT,

PROFESSOR PALMER, PROFESSOR ULLMANN, PROFESSOR MAC NUTT

The Conference Department provides extra instruction in Mathematics, Modern Languages, Physics, and Chemistry for Freshmen and Sophomores.

Any student who wishes to clear up some difficulty in the Mathematics, Modern Languages, Physics, or Chemistry of the Freshman or Sophomore year, should consult the teachers in the Conference Department.

Students may report at 7 o'clock any evening except Saturday.

There is no fee for instruction in the Conference Department.

EXTENSION COURSES

During the year 1920-21, the extension courses of the University have been of two kinds:

1. Courses not of collegiate grade given in the Lehigh Evening School, which is also the practice school of the Department of Philosophy and Education. These include courses in

Mathematics, Mechanical Drawing, Blue Print Reading, Machine Design, Applied Electricity and Metallurgy.

2. Courses certified to be of collegiate grade. Below is the list of such courses offered. All courses marked "G" may be offered by graduate students toward the higher degrees; courses marked "g" may be so offered under conditions prescribed by the department offering the course, and with the express consent of the Committee on Higher Degrees. The letter "e" is used to indicate courses that are open to students not matriculated in the University.

PHILOSOPHY, PSYCHOLOGY AND EDUCATION

PROFESSOR HUGHES, ASSISTANT PROFESSOR DROWN,

PHILOSOPHY. 1eg. HISTORY OF PHILOSOPHY. Leighton. (2) Evenings or Saturday.

PHILOSOPHY. 2e. THE RELIGION OF PHILOSOPHY. Plato, Spinoza, Kant, James. (2) Evenings.

PHILOSOPHY. 3e. ELEMENTARY LOGIC. Sellers. (2) Saturday A.M.

PHILOSOPHY. 4e. HISTORY OF SCIENCE. Libby. (2) Evenings.

PSYCHOLOGY. 1e. GENERAL PSYCHOLOGY. (2, 3 or 4) Afternoons.

PSYCHOLOGY. 2e. INTELLIGENCE. An introductory course in testing and developing intelligence. Dewey, Terman. (2) Evenings or Saturday.

PSYCHOLOGY. 3eg. INTELLIGENCE OF SCHOOL CHILDREN. Advanced course in tests, surveys and clinical studies. (2) Evenings or Saturdays.

PSYCHOLOGY. 4eg. SOCIAL PSYCHOLOGY. MacDougall, Wallas. (2) Evenings or Saturday.

PSYCHOLOGY. 5e. MENTAL HYGIENE. Principles of psychology and psychiatry applied to increasing efficiency and happiness of children and adults. James, Hall, White. (2) Evenings.

PSYCHOLOGY. 6e. CHILDHOOD AND YOUTH. Norsworthy and Hall. (2) Evenings.

EDUCATION. 1e. ELEMENTARY SCHOOL METHODS. (2) Evenings or afternoons.

EDUCATION. 2e. EDUCATIONAL MEASUREMENTS. The standard tests of achievement; how to use them. (2) Evenings or afternoons.

EDUCATION. 3eg. EDUCATIONAL MEASUREMENTS. Advanced course. Investigations and reports. (2, 3 or 4) Evenings, afternoons or Saturday.

EDUCATION. 4eg. THE PROJECT METHOD. Readings, reports, observation, experiment. (2 or 3) Evenings.

EDUCATION. 5eg. SECONDARY EDUCATION. Introductory course. Colvin. (2) Evenings.

EDUCATION. 6eG. SECONDARY EDUCATION. Advanced course. Inglis, Monroe, Johnston. (2, 3 or 4) Evenings.

EDUCATION. 7eg. JUNIOR HIGH SCHOOL. Briggs, Douglas, and others. (2 or 3) Evenings.

EDUCATION. 8eg. SCHOOL ADMINISTRATION. Cubberly; State (2): City (2) Evenings or Saturday.

EDUCATION. 9eG. SEMINAR IN EDUCATION. Reports and discussions. Saturday.

EDUCATION. 10e. HISTORY OF EDUCATION. *Athens, the Renaissance*, Rousseau; American Schools, schools of today and of tomorrow (3) Saturday or evenings.

ECONOMICS, PUBLIC LAW AND HISTORY

PROFESSOR STEWART, MR. MAC GREGOR

ECONOMICS. 1eg. SOCIOLOGY. Sociological and economic theory, and problems to which this theory may be applied.

HISTORY. 1e. INDUSTRIAL HISTORY of the United States. *Economic History of the United States*, Bogart; *Outline of Industrial History*, Cressy. (2) Saturday.

HISTORY. 2eg. POLITICAL AND SOCIAL HISTORY of Modern Europe. Lectures and discussions. Special reference to the causes of the recent war. (2) Evenings.

LATIN

PROFESSOR BLAKE

LATIN. 1e. A course corresponding to the work of the Freshman year in college. (2), (3) or (4). Evenings or Saturday A.M.

LATIN. 2eg. Advanced course in Latin Literature, suited to graduate students. Hour to be arranged.

FRENCH

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

FRENCH. 1e. ELEMENTARY FRENCH. (3) Evenings or Saturday A.M.

FRENCH. 2e. ELEMENTARY FRENCH, continued. Reading and conversation course. (3) Evenings or Saturday A.M.

FRENCH. 3eG. RECENT FRENCH LITERATURE. Investigation and discussion of phases of French life as exemplified in French literature; rapid reading. (3) Tuesday, Thursday, Friday, 3:30 to 6 P.M.

SPANISH

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

SPANISH. 1e. ELEMENTARY SPANISH. (3) Saturday A.M., or Tuesday, Thursday, Friday, 4:30 to 6 P.M.

SPANISH. 2e. ELEMENTARY SPANISH, continued. (3) Saturday A.M., or Tuesday, Thursday and Friday, 4:30 to 6 P.M.

GERMAN

PROFESSOR PALMER, ASSISTANT PROFESSOR MORE

GERMAN. 1e. ELEMENTARY GERMAN. German Grammar and Composition. Easy German Texts. (2) Saturday A.M.

GERMAN. 2e. INTERMEDIATE GERMAN. German Prose and Poetry. Heine, Keller, Meyer, Freytag, Storm, Heyse. (3) Saturday A.M.

GERMAN. 3e. Goethe's *Faust*, Part I, Lectures and Composition; or Nineteenth Century German Drama. (3) Saturday A.M.

GERMAN. 4eG. Goethe's Dramas, or Schiller's Life and Work, or Middle High German. (3) or (5) Afternoons, 4 to 6.

GERMAN. 5e. Teachers' Course in methods of teaching, discussion of text-books, phonetics of German, advanced German grammar and syntax, advanced composition. (2) Saturdays or afternoons.

ENGLISH

PROFESSOR THAYER, PROFESSOR LUCH,
ASSISTANT PROFESSOR MESCHTER, ASSISTANT PROFESSOR WALTERS

ENGLISH. 1e. PUBLIC SPEAKING.
ENGLISH. 2e. CONTEMPORARY DRAMA.
ENGLISH. 3e. VICTORIAN LITERATURE.
ENGLISH. 4e. RHETORIC AND COMPOSITION.
ENGLISH. 5e. SHAKESPEAREAN DRAMA.

MECHANICAL DRAWING

PROFESSOR LARKIN, ASSISTANT PROFESSOR QUAST

These classes meet twice a week, commencing Monday, September 27, 1920, on the top floor of Williams Hall.

The fee for Mechanical Drawing is $5.00 for a course of 60 hours, and for Machine Design is $10.00 for a course of 40 hours.

METALLURGY

PROFESSOR RICHARDS, ASSISTANT PROFESSOR ROUSH, MR. BUTTS

METALLURGY. 1e. GENERAL METALLURGY. (2) Evenings.

METALLURGY. 2e. METALLURGY OF IRON AND STEEL. (2) Evenings.

GEOLOGY

PROFESSOR MILLER, ASSISTANT PROFESSOR TURNER

GEOLOGY. 1e. GENERAL GEOLOGY. Lectures, field trips and laboratory. Study of geologic processes and results. (4) Saturday P.M.

GEOLOGY. 2e. GEOLOGY OF PENNSYLVANIA. Lectures, field trips and laboratory. Geological history of the State and its bearing on economic and political development. (4) Saturday P.M.

GEOLOGY. 3e. APPLICATIONS OF GEOLOGY to the teaching of Physical Geography. Illustrated lectures; discussion of school problems. (4) Evenings.

GEOLOGY. 4eG. The graduate courses listed on page 134 may be pursued as extension courses by qualified students.

BIOLOGY

PROFESSOR HALL, MR. FLORY

BIOLOGY. 1eg. GENERAL BIOLOGY. Lectures, laboratory and discussions. (2), (3), (4) Saturday P.M.

BIOLOGY. 2eg. COMPARATIVE ANATOMY. Lectures, laboratory and discussions. (2), (3), (4) Saturday P.M.

BIOLOGY. 3eg. BACTERIOLOGY AND SANITARY BIOLOGY. Lectures, laboratory and discussions. (2), (3), (4) Saturday P.M.

BIOLOGY. 4eg. EMBRYOLOGY. Lectures, laboratory and discussions. (2), (3), (4) Saturday P.M.

BIOLOGY. 5eg. The graduate course listed on page 136 may be pursued as an extension course by qualified students. Afternoons, 4 to 6, or Saturdays.

BIOLOGY. 6eg. FORESTRY. Lectures, laboratory and discussion. (3) Saturday P.M.

PHYSICS

PROFESSOR MAC NUTT, ASSOCIATE PROFESSOR CHARLES, ASSISTANT PROFESSOR FRY, ASSISTANT PROFESSOR FRAIM

PHYSICS. 1e. ELEMENTARY PHYSICS. A brief general course; lectures, demonstrations, recitations and laboratory. (4) Saturday P.M.

ELECTRICAL ENGINEERING

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT, ASSISTANT PROFESSOR BEAVER, ASSISTANT PROFESSOR GRUBER

CONSTRUCTIVE ELEMENTS OF ELECTRICAL APPARATUS. 1e. Studies of electrical machinery and appliances with the object of familiarizing the student with principles of operation, structural details, and practical uses. (2) Evenings.

ELECTROTECHNOLOGY. 2e. Review of the principles of electricity and magnetism, with special reference to their application to dynamo electric machinery; the elementary theory of direct current generators and motors; automatic starters and controllers; rates and costs; practical operation of dynamos; station equipment; storage batteries. DYNAMO LABORATORY. Experimental studies and tests of direct current generators and motors for characteristics, regulation efficiency, etc. Laboratory fee, $6, in addition to a charge of $15 for the course. (3) Evenings.

ELECTROTECHNOLOGY. 3e. Theory of alternating currents with applications to alternating current machinery and alternating current systems of transmissions, distribution and utilization; electric lighting. DYNAMO LABORATORY. Experimental studies and tests of alternating current generators and motors, synchronous converters, transformers, and auxiliary apparatus; measurement of power in polyphase circuits. Laboratory fee, $6., in addition to a charge of $15 for the course. (3) Evenings.

CHEMISTRY

PROFESSOR ULLMANN, ASSOCIATE PROFESSOR BABASINIAN

CHEMISTRY. 1e. ELEMENTARY CHEMISTRY, with laboratory. (2) or (4). Laboratory fee of $10, in addition to a charge of $10 for the single and $20 for the double course. A summer course only.

CHEMISTRY. 2e. ORGANIC CHEMISTRY. (2 to 4) Fee, $25, including laboratory. (3) or (4) Afternoon.

SUMMER SESSION, 1921

A summer session of the extension courses will open Tuesday, July 5, 1921, and continue for six weeks. Dormatories will be available at reasonable rates, for women in the Moravian College for Women, Bethlehem, and for men at the University.

In Psychology, special attention will be paid to mental diagnosis. In Education, there will be demonstration classes in elementary school subjects and in special classes, especially for supernormal children.

All courses in the Department of Philosophy, Psychology and Education are offered, and also the following: ENGLISH, 1e to 4e; FRENCH, 1e, 2e; METALLURGY, 1e, 2e; PHYSICS, 1e; PHYSICAL EDUCATION, gymnastics, swimming; GERMAN, 1e to 5e; GEOLOGY, 1e; CHEMISTRY, 1e.

A circular dealing with the Summer Session may be obtained by addressing the Registrar of the University.

EVENING SCHOOL OF BUSINESS ADMINISTRATION

The Lehigh University Evening School of Business Administration was organized in the fall of 1920 for business men in the vicinity of the University who desire a knowledge of the fundamental principles of the economics of business. A three year course is offered. Instruction is given three evenings a week, from 7:40 to 9:40 o'clock, by members of the teaching staff of the College of Business Administration.

Upon completing the course a student receives a certificate of proficiency. If he later enters the College of Business Administration, his Evening School credits will be accepted on an hour for hour basis.

The subjects of the Evening School of Business Administration are as follows:

First Year

BUSINESS LAW 1. Contracts and Negotiable Instruments.

The principles of contract; formation of contracts; operation and discharge of contracts; sales of goods; insurance contracts; principal and agent; master and servant; negotiable instruments.

Banking and Currency. A study of the banking system of the United States, comparing it with those of the important European states, together with a study of the currency and currency problems of this country. Special emphasis upon the Federal Reserve Act.

Accounting. A study of the fundamental principles of accounting with sufficient practise work to illustrate these principles. Theories of debit and credit; single and double entry; construction of accounts; special books; distinction between capital and revenue and the problems involved; construction and analysis of financial statements; equity accounts; valuation of assets; methods and problems of depreciation. Emphasis on the economic aspects of accounting.

Economics. Lectures on economics, supplementing the other work of the school; optional.

Second Year

Business Finance (2 Years). An exposition of the essential principles of sound financing; the different forms of financial organization; stocks and bonds; sale of securities, promotion and underwriting; financial management and irregularities and mismanagement.

Corporation Law. Formation, management, dissolution, merger and consolidation of corporations. Rights, powers and liabilities of stockholders, directors and officers. General principles of contract law applied to corporate questions.

Corporation Accounting. The application of accounting principles to corporations, corporation accounts and records. The voucher system; construction and analysis of corporation statements and reports; assets of corporations and their valuation; capital stock and the stock books; bonds and other forms of indebtedness; distribution of profits; handling surplus and reserves; sinking and other funds; liquidation of a corporation; combinations and consolidations; branch house accounting. Considerable practise work. Problems selected largely from examinations for Certified Public Accountancy.

Third Year.

(Three subjects to be chosen.)

AUDITING.
MANUFACTURING ACCOUNTS.
INDUSTRIAL ADMINISTRATION.
ECONOMICS.
LAW.
INVESTMENTS.
GOVERNMENT REGULATION OF BUSINESS.
ADVERTISING.
FOREIGN TRADE.
INSURANCE.

A circular giving entrance requirements, fees and other details may be obtained by addressing the Registrar of Lehigh University.

EVENING COURSES IN NAVAL ARCHITECTURE

In response to requests from members of the technical and drafting departments of the Bethlehem Ship Building Corporation, whose main office building is near the campus, Lehigh University in the fall of 1920 instituted Evening Courses in Naval Architecture and Marine Engineering. For the current year the work offered includes three collegiate courses: Elements of Naval Architecture, Elements of Strength of Materials, and Elements of Steam Power. The latter two will furnish the basis for a course in Marine Engine Design, planned for 1921-1922. Instruction is given three evenings a week, from 7:30 to 9:30 o'clock, by teachers of the College of Engineering of the University.

The contents of the courses now being given are as follows:

ELEMENTS OF NAVAL ARCHITECTURE: Areas and centers of gravity of areas; Simpson and trapezoidal rule; displacement and center of buoyancy calculations; displacement sheet; use of the integrator in calculating displacement and vertical center of buoyancy; transverse metacentric height; inclining experiments; trim; displacement and other curves; launching calculation.

ELEMENTS OF STEAM POWER: Heat power plant cycles; properties of gases and steam; steam engine operation; compounding of engines; valves and valve setting; regulation of engines; steam turbines; condensers and related apparatus; combustion and fuels; boilers and boiler auxiliaries.

ELEMENTS OF STRENGTH OF MATERIALS: Strength and weight of engineering materials; elastic limit; tensile, compressive and shearing strengths; modulus of elasticity; theory of beams; flexure of beams; investigation and design of beams; columns; torsion; design of shafts; transmission of power by shafts; combined stresses; impact and fatigue; centrifugal stresses.

SUMMER TERMS

Summer term courses are required as follows: Land and Topographic Surveying at the end of the Freshman year in the courses in Civil Engineering, Mining Engineering and Ship Construction and Marine Transportation; Constructive Elements of Machinery and of Electrical Apparatus at the end of the Freshman year in the courses in Mechanical Engineering, Metallurgy, Electrical Engineering and Chemical Engineering; Mechanical Technology at the end of the Sophomore year in the courses in Mechanical and Electrical Engineering; Assaying at the end of the Sophomore year in the courses in Metallurgy, Mining Engineering and Chemistry; Assaying and Industrial Mineralogy at the end of the Sophomore year in the course in Chemical Engineering; Engineering Laboratory at the end of the Junior year in the courses in Mechanical Engineering and Chemical Engineering; Mine and Railroad Surveying at the end of the Junior year in the course in Mining Engineering. Students may, with the approval of the heads of their Departments, substitute industrial work for summer courses. Students not connected with the University may be admitted to these courses if properly qualified.

GRADUATE COURSES

Courses leading to the degree of Master of Arts or Master of Science may, by permission of the Faculty, be pursued by any properly qualified person who has taken the Bachelor's degree or a degree in technology at any recognized college, university or technical institution. These courses require at least one year of advanced study in residence at Lehigh University in two departments (under two professors), or at least two years of such study in non-residence. Residence is construed as continuous attendance at the University and living under its jurisdiction. Permission to enroll for study in non-residence will be granted only in exceptional cases to students who possess ample facilities for study and work and usually only to students who can report periodically in person for conferences with the professors under whom they are studying.

The course of study selected must consist of at least fifteen exercises a week. Two-thirds of the work, ten hours a week, including a thesis, if required, must be chosen in one department called the major department. The work in the major department is to be selected from the list of graduate studies. About one-third of the work is to be in another department, called the minor department, and may be chosen from the list of graduate studies or from other advanced courses offered by the University. The candidate is required to satisfy each professor concerned that he is fully competent to pursue the subjects selected.

Candidates may be enrolled at any period of the college year, but preferably at the beginning of the regular terms in September and February.

The fees for instruction are $100 a year for students in residence, and $50 a year for students in non-residence, payable in advance (or as arranged with the Bursar's office). Fees for students in residence are payable in two instalments of $60 and $40 at the beginning of the first and second terms respectively. A student in residence who takes more than one year shall have returned to him a pro-rata part of his payment for the second, or other succeeding years, if he finishes in a fraction of that year. A student in non-residence shall pay

for the first two years; no fee will be required for the third year, but succeeding years, if necessary and permitted by the Faculty, shall be paid for at the rate of $50 a year. The graduation fee of $10 is required of all students.

After passing examinations in the assigned studies, presenting a satisfactory thesis as evidence of ability to do original work, if required by the professor concerned, and paying all required fees, the candidate will be recommended by the Faculty to the Trustees for the Master's degree appropriate to the course pursued.

Some of the University Extension Courses listed on page 125 are designated as graduate courses. As these are given late in the afternoon, or in the evening, or on Saturdays, they are especially adapted to teachers and others who are enrolled as graduates in non-residence.

The following graduate studies are now offered by the University:

MATHEMATICS AND ASTRONOMY

PRACTICAL ASTRONOMY

PROFESSOR THORNBURG, PROFESSOR OGBURN

The study of instruments and methods used in the determination of time, latitude, longitude and azimuth; practical work in the observatory, securing facility in making and reducing observations. Two terms (5).

DIFFERENTIAL EQUATIONS

PROFESSOR LAMBERT

Course in Differential Equations based on Johnson's *Differential Equations* and Byerly's *Spherical Harmonics.* Collateral reading in the University Library required. Two terms (3).

ANALYTIC MECHANICS

ASSISTANT PROFESSOR REYNOLDS

Elementary and Advanced Rigid Dynamics; Potential Functions, based on Love's *Theoretical Mechanics;* Williamson and Tarleton's *Dynamics;* and Routh's *Dynamics.* Two terms (3).

DIFFERENTIAL GEOMETRY

ASSISTANT PROFESSOR KNEBELMAN

Parametic representation of plane and skew curves and surfaces, theory of contact, curvature, differential invariants, in-

trinsic equations, trajectories, equations of Césaro, curvilinear coordinates, equations of Lamé.

Representation of one plane upon another, conformal and spherical representation, equations of Gauss and Godazzi, theory of applicability. Two terms (2).

ENGLISH

ENGLISH LITERATURE

PROFESSOR THAYER

An advanced course in branches which have not formed a part of the undergraduate work of the candidate, details to be arranged after a personal conference. Two terms (5).

ANGLO-SAXON

ASSISTANT PROFESSOR MESCHTER

Anglo-Saxon poetry and prose above the grade of undergraduate work, from both the literary and the historical points of view. Two terms (5).

ENGLISH PHILOLOGY

PROFESSOR LUCH

An advanced course in the principles of Teutonic philology as applied to the origin and development of the English language. Two terms (5).

SANSKRIT

PROFESSOR THAYER

Beginner's Course. Perry's *Primer*. Lanman's *Reader*. Whitney's *Grammar*. Two terms (5).

ECONOMICS AND HISTORY

POLITICAL ECONOMY

PROFESSOR STEWART

The rise and development of economic systems and economic thought; the scope and method of political economy. Patten's *Development of English Thought* and the works of Keynes, Cohn and Ingram on political economy are used. Two terms (5).

AMERICAN HISTORY

PROFESSOR STEWART

An examination of the influence of the economic development of the Union upon the legal and political theories incorporated in the Constitution. Two terms (5).

POLITICS

PROFESSOR STEWART

The history of the attempt to treat in a systematic way the problems of political organization. Pollock's *History of the Science of Politics* and Sidgwick's *Elements of Politics*. Two terms (5).

LATIN

PROFESSOR BLAKE

An advanced course in the Latin language and literature, arranged with each candidate individually upon application. Two terms (5).

GREEK

Advanced courses, of which the following are specimens, will be arranged upon application:

HELLENISTIC GREEK

PROFESSOR GOODWIN

Gospel of St. Mark, *Acts*, and selected *Epistles of the New Testament*. Thayer's *Lexicon*. Blass's *Grammar of New Testament Greek*. Patristic literature. Collateral reading. Selections from Lucian. Two terms (5).

DRAMATIC POETRY

PROFESSOR GOODWIN

Several plays of Aeschylus, Sophocles, Euripides, and Aristophanes. Aristotle's *Poetics*. Collateral reading. Two terms (5).

GREEK PHILOSOPHY

PROFESSOR GOODWIN

Plato's *Republic* and other works. Aristotle, selections. Ritter and Preller's *Historia Philosophiae Graecae*. Zeller's *History of Greek Philosophy*, and other collateral reading. Two terms (5).

ELECTRICAL ENGINEERING

THEORY OF ALTERNATING CURRENTS AND ALTERNATING CURRENT MACHINERY

PROFESSOR ESTY

A course based upon the works of Arnold, Bedell and Crehore, Steinmetz, and Lawrence. Two terms (4).

ELECTRICAL DESIGN

PROFESSOR ESTY

A course consisting of predeterminations by calculation of the characteristics, regulation and performance of electrical machinery. Analysis and use of designing constants. Design of special machines. Two terms (3).

ELECTRIC TRACTION

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT

The development of an electric railway project. Design of station and distribution system. Operating characteristics of direct and alternating current railway motors. Predetermination of motor equipment and run curves for given schedules and traffic. Choice of system. Estimates of costs. Two terms (3).

ELECTRICAL TESTING

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT

Special experimental research in electrical engineering; tests of the magnetic properties of iron and steel; investigation of the series single-phase alternating current motor; leakage reactance of induction motors; regulation of alternators; polyphase testing; electric railway testing. Two terms (3).

RADIO COMMUNICATION

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT, ASSISTANT PROFESSOR ESHBACH

The theory underlying the various sending and receiving systems, and the propagation of electromagnetic waves, combined with experimental work in connection with the department's wireless equipment. Two terms (2).

METALLURGY

THERMO-CHEMISTRY AND THERMODYNAMICS OF THE METALS

PROFESSOR RICHARDS, ASSOCIATE PROFESSOR ROUSH

A study of the melting points, vapor tensions, specific heats, and latent heats of fusion and of vaporization of the metals, from practical and theoretical viewpoints; also, of the heats of formation of compounds of the metals, and the relation of these to atomic weights and other chemical and physical properties. Lectures and laboratory work. First term (5).

THERMO-CHEMISTRY AND PHYSICS OF METALLIC ALLOYS

PROFESSOR RICHARDS, ASSOCIATE PROFESSOR ROUSH

A study of the physical and chemical properties of metallic alloys, their melting points, specific heats, latent heats of fusion, heats of formation and microscopic structures. Lectures and experimental work. Second term (5).

ELECTROMETALLURGY

PROFESSOR RICHARDS, ASSOCIATE PROFESSOR ROUSH

A study of the conditions of deposition of metals and alloys in electrolysis, electrolytic separations, formation of metallic compounds by electrolysis, energy absorption in electrolysis. Lectures and laboratory work. First term (5).

MINING ENGINEERING

METHODS OF MINING

PROFESSOR ECKFELDT

The study of methods used in a given mining region, or in the production of a given class of mineral, with respect to conditions influencing choice of method and cost. Two terms (5).

MINING PLANT

PROFESSOR ECKFELDT

The determination of the efficiency of mining machinery of given types under varying conditions. Two terms (5).

ORE DRESSING PLANT

ASSISTANT PROFESSOR BARTLETT

The study of certain operations incident to the dressing of ores or the preparation of coal. Determination of efficiency of machines and processes. Losses in dressings. Two terms (5).

GERMAN

PROFESSOR PALMER, ASSISTANT PROFESSOR MORE

The German Drama of the Nineteenth Century. First and second terms (3).

Lessing as Dramatist and Critic. First and second terms (3).

Middle High German. Wright's *Middle High German Primer*, Bachmann's *Mittelhochdeutsches Lesebuch*, Nibelungenlied. First term (3).

Middle High German. Gudrun, Wolfram von Eschenbach, Gottfried von Strassburg, Walter von der Vogelweide. Lectures on Middle High German literature. Second term (3).

GEOLOGY

GEOLOGICAL INVESTIGATION

PROFESSOR MILLER

The investigation and study of the literature of some special geological problem. Field and laboratory work on some district; map of a limited area; an investigation of the microscopic character and general structural features of the rocks which are exposed; presentation of a thesis or dissertation embodying these results. Preparation required dependent upon the nature of the problems to be studied. Two terms (4).

ECONOMIC GEOLOGY

PROFESSOR MILLER

Advanced work in ore deposits. Study of the literature and of the theories of ore deposition, together with detailed work on the type occurrences of some of the metallic or non-metallic minerals. Thorough investigation and report on some mining district with special regard to the origin of the ores and such commercial aspects of the deposits as may depend chiefly on the geology. Preparation required: 270 or 271. Two terms (6).

PETROGRAPHY

ASSISTANT PROFESSOR TURNER

A critical study of recent advances in petrographic methods and nomenclature. Preparation of a detailed report on a selected problem. Preparation required: 266, 268, 269 and 276. Second term (3).

PHYSIOGRAPHY

PROFESSOR MILLER

The detailed study of physiographic types and processes. Conferences, reports and thesis, with work in the laboratory and field. A training in elementary physiography and general geology required as a pre-requisite. Two terms (4).

PHYSICAL CRYSTALLOGRAPHY

ASSISTANT PROFESSOR TURNER

An advanced course in the geometrical and physical properties of crystals, with special reference to the Goldschmidt methods of crystal measurement and projection. First term (4).

BIOLOGY

VERTEBRATE HISTOGENESIS AND ORGANOLOGY

PROFESSOR HALL

Lectures, reading, and laboratory work. Careful following, in the laboratory, of the development of a vertebrate, tracing of the history of the germ-layers, organs and tissues. Organology dealing with the association of tissues to form organs. Preparation required: 292, 293, 294. First term (3).

PHILOSOPHY, PSYCHOLOGY AND EDUCATION

PROFESSOR HUGHES, ASSISTANT PROFESSOR DROWN

The following undergraduate courses may count toward an advanced degree provided additional work is taken in connection with them: History of Philosophy, ancient and modern, History of Education, Educational Psychology, Principles and Practice of Teaching, and Psychological Studies. More advanced courses in Psychology, Logic, Ethics and Metaphysics, may be outlined to meet the needs of competent students.

The following is the course that commonly is followed by those who select Education as the major study: Educational Psychology, two year hours; School Administration, two year hours; Secondary Education, two year hours; Seminar in Education, with Thesis, four year hours. Most students in the field of Education find it convenient to avail themselves of the Extension Courses, which are listed on page 122.

GRADUATE COURSES

PROFESSOR HUGHES

History of Philosophy, advanced course. Two terms (2).

Seminar in Philosophy. Two terms (2).

Social Psychology. A. The relation to essential human needs of the several forms of culture—sport, art, the moral

and religious consciousness, and the spirit of science; their origin and development. One term (2). B. Psychological measurements and mental hygiene. One term (2).

Greek Education. One term (2).

ASSISTANT PROFESSOR DROWN

Educational Measurements. Investigation and reports. One term (2).

Secondary Education. Two terms (2).

School Administration. Two terms (2).

Seminar in Education. Two terms (2).

FRENCH

LITERATURE

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

An advanced course in French Literature. The course is arranged with each candidate individually upon application. Two terms (5) or (10).

LANGUAGE

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

A. OLD FRENCH. Grammar. Easier texts. Chanson de Roland. First or second term (2) or (3).

B. OLD FRENCH. Reading and explanation of texts. First or second term (2) or (3).

C. ROMANCE PHILOLOGY. Sound change. Word formation. First or second term (2) or (3).

D. ROMANCE PHILOLOGY. Syntax. First or second term (2) or (3).

SPANISH

LITERATURE

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

An advanced course in Spanish Literature. First or second term (2) or (3).

LANGUAGE

PROFESSOR FOX

OLD SPANISH. Grammar. Readings. First or second term (2) or (3).

ITALIAN

PROFESSOR FOX

Dante's *Inferno*. Lectures and outside reading. First or second term (2) or (3).

CHEMISTRY

ADVANCED INDUSTRIAL CHEMISTRY

PROFESSOR ULLMANN, ASSOCIATE PROFESSOR CHAMBERLIN

Study of some industry dependent upon chemical principles and consists of experimental and analytical work in the lab- consisting of experimental and analytical work in the lab- study of the technical journals and other publications. Two terms (10).

ADVANCED ORGANIC CHEMISTRY

ASSOCIATE PROFESSOR BABASINIAN, ASSOCIATE PROFESSOR COBB

Original investigations in organic chemistry. Two terms (10).

ADVANCED ANALYTICAL CHEMISTRY

PROFESSOR ULLMANN, ASSOCIATE PROFESSOR DIEFENDERFER

Study and comparison of known methods of quantitative analysis and the development of new methods. Two terms (10).

PHYSICAL CHEMISTRY

ASSISTANT PROFESSOR EWING

Original investigations in physical chemistry. Two terms (10).

PHYSICS

THEORETICAL PHYSICS

PROFESSOR MAC NUTT, ASSOCIATE PROFESSOR CHARLES

Elective courses in the following subjects: (*a*) The Theory of Heat, based upon Preston's *Theory of Heat*, Buckingham's *Thermodynamics*, and Nernst's *Theoretical Chemistry;* (*b*) The Theory of Electricty and Magnetism, based upon Maxwell's Treatise, J. J. Thompson's *Recent Researches*, and *Conduction of Electricty Through Gases*, and Hertz's *Electric Waves*; (*c*) The Theory of Light, based upon Preston's *Theory of Light*, Drude's *Theory of Light*, Wood's *Physical*

Optics, and Edser's *Light for Advanced Students*. First and second terms (3) to (5).

PHYSICAL RESEARCH

PROFESSOR MAC NUTT, ASSOCIATE PROFESSOR CHARLES

Opportunity afforded advanced students to pursue experimental investigations in physics. First and second terms (2) to (4).

CIVIL ENGINEERING

BRIDGE DESIGN

PROFESSOR FOGG

The theory of suspension and arched structures, with the preparation of general plans and estimates, and the economic comparison of different types. Two terms (4).

TESTING OF MATERIALS

PROFESSOR FOGG, ASSISTANT PROFESSOR FULLER

The properties of materials of construction, with special reference to inspection and testing. Original researches by the student in the laboratory. Detailed attention to the work on the unification of methods of testing done by the International Association for Testing Materials. Two terms (5).

RAILROAD ENGINEERING

PROFESSOR WILSON

The economic location of railroads, as influenced by probable volume of traffic and cost of operation. A course based on Wellington's treatise, with detailed discussion of special cases. Two terms (2).

SANITARY ENGINEERING

ASSISTANT PROFESSOR PAYROW

The designing of reservoirs, tanks, and pipe lines for water supply systems, and of sewers and other appurtenances for sewerage systems. Inspection of existing plants, with reports thereon. Two terms (4).

NAVAL ENGINEERING

ADVANCED SHIP DESIGN

PROFESSOR CHAPMAN

Advanced work in the design of cargo and passenger ships. The relation of size and speed of ships for the most

economical performance in service; a study from actual layouts of the relative merits of various types of propelling machinery; subdivision and flooding calculations according to the rules of the Bulkhead Committee of the Board of Trade.

The design of special types of ships and sailing yachts. Two terms (5).

THE POWERING AND PROPULSION OF SHIPS

PROFESSOR CHAPMAN

An advanced course consisting of a study of powering and propeller data and a comparison of the work of various investigators. Two terms (2).

THE STRENGTH OF SHIPS

PROFESSOR FOGG, PROFESSOR CHAPMAN

Investigation of the stresses set up in a ship's structure with particular application to special types of construction. Two terms (3).

TUITION AND OTHER FEES

The tuition fees for all students from September, 1920, are as follows: In the College of Engineering, $300 for the year or $180 for either term; in the College of Business Administration, $250 for the year or $150 for either term; in the College of Arts and Science, $200 for the year or $120 for either term.

The tuition for Chemistry offered in the Summer term immediately following Commencement Day is $15; for all other subjects $20. No charge is made for such subjects to students who have paid tuition for the previous year, provided the subjects in question are a scheduled part of the technical courses they are pursuing. A graduation fee of $10 is paid by all candidates for a degree. A registration fee of $10 is paid by each student yearly.

All fees are payable at the office of the Bursar in Drown Memorial Hall. Tuition fees are payable in two instalments, on the opening day of the college year in September, and on the first day of the second term in February. The first instalment is $180, or $150, or $120, according to the course, and the second instalment is $120, or $100, or $80, according to the course. Application may be made for a return of part of

the tuition fee when a student has formally withdrawn from the University after less than four weeks' attendance in either term, but the amount thus refunded will in no case exceed one-half of the last instalment paid.

Students who fail to pay tuition fees when due will be notified that their attendance at college exercises must be discontinued until payment is made.

EXPENSES

Books, stationery, and drawing instruments may be bought by students at low prices at the Supply Bureau in Drown Memorial Hall. For work in the laboratories, materials may be obtained from the University, students making a deposit at the opening of the term covering the value of the materials. The amounts of these deposits are given under the detailed statements of laboratory courses in the List of Studies.

The University dormitories accomodate 174 students. The charge for single rooms is $80 a year; suites of three or four rooms rent at $100 for each occupant.

Students may obtain table board at the College Commons. The rate is $30 for thirty consecutive days. Numerous private householders in the city offer rooms and board at moderate charge.

Necessary expenses for the collegiate year, clothing and traveling not included, are estimated at $500 in addition to tuition. This includes attendance at the required summer schools.

SITE

Bethlehem is situated at the junction of the Lehigh Valley, the New Jersey Central and the Philadelphia and Reading Railroads. The university buildings are about a half-mile from the station. New York is eighty-six and Philadelphia fifty-seven miles distant.

BUILDINGS AND GROUNDS

The University occupies nineteen buildings, and its grounds cover 160 acres on the north side of South Mountain, overlooking the valley of the Lehigh river and the city of Bethlehem.

PACKER HALL

Packer Hall, completed in 1869, is four stories in height, 215 feet long, and 60 feet wide. It is built of Potsdam sandstone in the English Gothic style of architecture.

The Department of Civil Engineering occupies the greater part of the first and second floors of Packer Hall. On the first floor are a lecture room, two recitation rooms, a large drawing hall, two instrument rooms, two offices and a library room. The instrument rooms contain seventeen transits, fourtween levels, a large geodetic theodolite, two plane tables and other instruments for engineering field work. In the library room is a collection of plans of engineering structures. On the second floor are two drawing-rooms, three recitation rooms, an instrument room, a blue-print room, and offices.

On the third and fourth floors are to be found the offices and recitation rooms of the Department of Mathematics and Astronomy.

The offices of the President, Vice-President, Secretary of the Faculty and Registrar are on the second floor of Packer Hall.

THE CHEMICAL AND METALLURGICAL LABORATORIES

The Chemical and Metallurgical Laboratories are contained in a fire-proof sandstone building, 259 feet in length by 44 in width, with two wings, each 62 feet in length by 42 feet in width.

In the Chemical department there are two principal stories, a basement and a topmost story given over to the laboratory for physical chemistry. The upper floor is occupied by the quantitative and the qualitative chemical laboratories. These rooms are 22 feet in height, and are well lighted and ventilated. Laboratories for research chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a smaller lecture room, a recitation room, a chemical museum, and laboratories for organic chemistry and sanitary chemistry.

In the basement is a large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis; also rooms containing the apparatus for processes in industrial chemistry, steam engine and dynamo and motor installation, air pump for pressure and vacuum filtration, etc.

The University has just completed an extension of the Chemical Laboratory. It is three stories high, in architectural conformity with the main building, and has inside dimensions of 60 feet by 37 feet. The equipment of these laboratories is of the most modern type, and every accessory to comfort and efficiency in expediting laboratory work is provided.

The Metallurgical department contains a lecture room; a museum of metallurgical collections; a laboratory provided with a spectroscope, a simple and a polarizing microscope, two Le Chatelier microscopes complete with camera; a dry laboratory provided with furnaces for solid fuel and for gas, with natural draught and with blast, electric current for electrometallurgical experiments, and a wet laboratory for ordinary analytical work. Equipment is provided for laboratory work in metallurgy, in metallography, and particularly in electrometallurgy, consisting of gas, electric current and apparatus for various kinds of experimental work. Several new pyrometers, calorimeters, and furnaces have been added to the general equipment. This department is therefore well arranged and equipped for the instruction of classes in metallurgy and electrometallurgy of the regular curriculum, to afford facilities to students for familiarizing themselves with the methods of measurement and research employed in metallurgy and electrometallurgy, and for conducting original investigation in these departments of science.

THE PHYSICAL AND ELECTRICAL LABORATORY

The Physical and Electrical Engineering Laboratory is 240 feet long, 44 to 56 feet wide, and four stories high. The halls and stairways, the photometer rooms, and all aparatus rooms are of fire-proof construction. The remainder of the building is of heavy mill construction.

On the first floor are the Advanced Electrical Laboratory and shops of the Physics Department, the Senior and Junior dynamo laboratories, the shop and research room of the Electrical Engineering Department, and a storage battery

room belonging jointly to the Departments of Physics and Electrical Engineering.

The dynamo laboratory for Senior students in the west wing is supplied with power from a 75-kilowatt rotary converter receiving current from the University power plant through two 30 kilowatt transformers. The dynamo laboratory equipment, which is being constantly increased, now includes the following apparatus: an 18-kilowatt double current generator, two direct current motor-generator units, one Lincoln variable speed motor, a 4-kilowatt Westinghouse two-phase rotary converter, a 10-kilowatt General Electric six-phase compound rotary converter, two direct connected units consisting of 7½-kilowatt six-phase General Electric alternators driven by 15-horse power Allis-Chalmers motors, one 20-kilowatt two- (or three-) phase alternator built by the Department, a 35-kilowatt Westinghouse single-phase alternator, a 10-kilowatt composite wound alternator driven by a 15-horse power Crocker-Wheeler motor, a pair of 3-horse power direct connected series crane motors, three motor-generator sets converting from alternating to direct current, four polyphase induction motors ranging from 2-horse power to 7½-horse power, three types of single-phase induction motors, two single-phase commutator motors, twenty-two transformers of from 1 to 15-kilowatts, including two 15-kilowatt Scott-connected transformers, a 5-kilowatt 66,000-volt testing transformer, a 6-light constant current transformer, a 30-ampere arc rectifier outfit complete, a General Electric oscillograph outfit, a Crane lecture room oscillograph, and a variety of instruments, including voltmeters, ammeters, watt-meters, rheostats, contact makers, frequency meters, dynamometers, condensers, and other apparatus.

The dynamo laboratory for Junior students on the first floor in the west wing contains the following apparatus: a 20-kilowatt Ferranti alternator driven by a direct current motor, two arc light machines, twenty arc lamps of various types, a Brackett cradle dynamometer, a Westinghouse two-phase rotary converter, a motor driven battery-booster set, several types of adjustable speed motors, and other motors for direct and alternating currents.

On the second floor are the offices of the Department of Physics and of Electrical Engineering, two general apparatus

rooms, a large laboratory room for Physics, a large dynamo laboratory for Sophomore students in Electrical Engineering, and an Electrical Engineering reading room. The dynamo laboratory for Sophomore students in the west wing is equipped with twenty-seven direct current machines of various types, dynamotors and several types of automatic starters and auxilliary apparatus. Apparatus exemplifying the operation of telegraph, telephone, and radio telegraph and telephone stations are here installed. The equipment in radio telegraphy and telephony includes a 250-foot antenna, 5-kilowatt transformer, oscillation transformer, quenched gap, and several sets of receiving apparatus.

On the third floor are the lecture room, apparatus rooms and photometer rooms of the Department of Physics, and lecture room, recitation rooms, apparatus room, and drawing-room of the Department of Electrical Engineering.

On the fourth floor are recitation rooms and two large laboratory rooms of the Department of Physics.

THE W. A. WILBUR ENGINEERING LABORATORY AND POWER HOUSE

The W. A. Wilbur Engineering Laboratory was erected in 1902; in 1907 the original building was doubled in size, the addition containing the new heating and lighting plant of the University. The building is of sandstone, conforming in material to the adjacent Chemical and Physical Laboratories. It is 44 feet wide by 188 feet long, one story high in the boiler room, but with a raised engine room forming a second story at either end.

The boiler equipment of the laboratory consists of two watertube boilers rated at about 100-horse power each, one of Babcock & Wilcox type, the other of Sterling make. In the heat and light plant there are three 250-horse power Sterling boilers, with room for a fourth unit of equal or greater capacity. Each section has its own set of feed pumps and other auxilliaries, in the arrangement of which special provision has been made for easily conducting performance tests. The laboratory boilers are connected to the chimney of the old boiler house, and have also an induced draft outfit. The chimney of the newer plant is of radial brick construction, 125 feet high, and a forced draft equipment is to be installed when need for increased capacity arises.

A coal-storage yard north of the building has room for a season's supply of coal, and a system of belt-conveyors and bucket-elevator is provided for receiving coal, dumping it on storage pile, and conveying it into the boiler room as needed.

The engine room of the laboratory, 50 feet long, contains a vertical triple-expansion engine of 75-horse power, a 60-horse power compound two stage Ingersoll air compressor, a small tandem-compound yacht engine, a simple Ball engine direct connected to a 25-kilowatt Crocker-Wheeler generator, and a 5-horse power De Laval steam turbine. There is also a complete set of Westinghouse airbrake apparatus, with four freight car brakes. The airbrake pump and all the other small motors, including the feed and condenser pumps, are piped to the surface condensers beneath the engine room floor. There are two large condensers of 150- and 60-horse power capacity respectively, with smaller ones for the pumps and for special experiments. Besides the various engines there is a large belt dynamometer, apparatus for testing guages, indicators, thermometers, steam calorimeters and other instruments, and for experiment on flow of steam, for testing injectors, etc. The exhaust system includes a Cochrane feed-water heater of 250-horse power capacity.

The engine room of the power house is 31 feet long, with concrete floor. The generating units now installed are of 50 and 100-kilowatt rating, and there is room for a third of larger size. Simple horizontal Ball engines are direct connected to General Electric alternating current generators, which furnish 60-cycle two-phase current at 2200 volts for transmission to the various distributing centers. An engine-driven and a motor-driven exciter, with the switchboard, complete the electrical equipment. The engines exhaust through a Cochrane heater, and the exhaust steam is discharged directly into the low-pressure system during the heating season.

A floor space 45 feet by 70 feet in the old boiler house is now used as a laboratory. It contains a 150-horse power suction gas producer for anthracite coal and apparatus for gas-power engineering and hydraulics, and for minor thermodynamic experiments with steam.

This building bears the name of Mr. W. A. Wilbur in grateful recognition of the work he had done for Lehigh University.

WILLIAMS HALL

Williams Hall was the donation of Dr. Edward H. Williams, Jr., of the Class of '75, and was so named by the Trustees of the University not only in recognition of this gift but also of Dr. Williams' long continued and important service to the University as an alumnus and as Professor of Mining and Geology.

Williams Hall is 186 feet long by 70 feet wide and covers a ground area of over 12,000 square feet. One-half of the building is devoted to the Department of Mechanical Engineering and the other half to the Departments of Geology and Biology.

In the eastern end there are recitation rooms, instructors' office, drawing-rooms, reference library, and store-rooms of the Department of Mechanical Engineering, and in the basement rooms and apparatus are provided for laboratory work in experimental mechanics and engineering physics, such as the calibration of the measuring instruments used in Mechanical Engineering, the determination of the mechanical efficiencies of hoisting and other gear, and the testing of motors. In this section there are electric motors, a water motor, a 15-horse power centrifugal pump, hoists, blocks, jacks, and dynamometers of various kinds.

In the west end the Department of Geology has on the first floor two lecture rooms, two offices, library, mineralogical museum, and laboratory of petrology and petrography. The lecture rooms contain specimens of rocks and fossils and a collection of economic minerals and ores. The main lecture room is fitted with a stereopticon for illustrated lectures. The laboratory of petrography is provided with fifteen high-grade petrographic microscopes, and study collections of rocks and minerals. The collection of rocks contains over six thousand specimens from type regions in different parts of the world. The mineralogical museum contains many valuable collections representing all the prominent mineral localities in the world. In the basement are the mineralogical laboratory, the blowpipe laboratory, a small chemical laboratory for analytical work, and a room fitted with apparatus run by a one-horse power motor for cutting thin sections of rock. On the second floor is the paleontological museum, which contains the fossil collections. On the third floor is a room fitted as an

office and laboratory, containing a Goldschmidt's two-cycle goniometer and other apparatus for advanced work in crystallography.

On the third floor there are the drawing-room and an office of the Mining Department, also well-equipped blue-print and dark rooms and a photographic laboratory used jointly by the Departments of Mining and Geology.

The Department of Biology has its lecture room, office, reference library, laboratories, and store rooms on the second floor, and a large vivarium on the third floor. The laboratories of this Department are thoroughly equipped with collections, sections, microscopes and necessary appliances.

Two students' rooms, used by the Mining and Geological Society and by the Mechanical Engineering Society, are located in the basement.

THE FRITZ ENGINEERING LABORATORY

The late John Fritz, of Bethlehem, known as the father of the steel industry in the United States, and a member of the Board of Trustees dating from the founding of the University, gave to the University the funds for the erection and thorough equipment of an engineering laboratory. The building was designed and erected in 1910 under the personal supervision of Mr. Fritz. The building is equipped with a general testing section for testing iron and steel, a cement and concrete section, and a hydraulic section. The equipment is used by the Civil Engineering Department in connection with courses in Strength of Materials, Hydraulics, and Cement. Any student in the University who has the proper preparation may receive instruction in this laboratory.

The building is of modern steel frame construction, 94 feet wide and 115 feet long, with the main central section 65 feet in height, and two side sections of lesser height. The external walls which enclose the steel frame are of cement brick lined on the inside with red brick. A traveling crane, of 10-ton capacity, operated by electricity, commands the entire central portion of the building in which the testing of large specimens is carried on.

The general testing section is equipped with an 800,000-pound Riehlé vertical screw testing machine, capable of testing columns 25 feet long or less, tensile specimens 20 feet long

or less, and transverse specimens up to lengths of 30 feet; an Olsen universal testing machine of 300,000 pounds capacity; smaller machines for ordinary tension, compression, transverse and torsion tests; a cold-bend testing machine, and a small machine shop. The hydraulic section occupies the east end of the main room and is equipped with various tanks, weirs, pumps and other apparatus for studying problems in hydraulics. The cement and concrete section has a large room for the making and testing of specimens and a room for the storage of materials.

THE ECKLEY B. COXE MINING LABORATORY

The Eckley B. Coxe Mining Laboratory is a building of dressed sandstone, 100 feet long by 75 feet deep, one story high in front with a raised floor in the rear.

The main part of the building contains the Ore Dressing Laboratory, 40 feet by 70 feet; the west wing contains a chemical laboratory, an assay room, a balance room, and a sampling laboratory; the east wing contains the office, recitation room and an instrument room. There is a locker and wash room in the basement of the east wing.

The equipment for the main laboratory, most of which was made by the Allis-Chalmers Co., consists of a gyratory crusher, rolls, screens, jigs, Huntington mill, classifiers, concentrators (tables and vanner), gravity stamps, amalgamating plates, grinding pan, and cyanide plant, with the necessary apparatus including grizzly, elevators, feeders, sand-pumps, settling tanks, zinc boxes, filter press, dryers, crawls, blocks, and electric motors. The sampling laboratory contains a small jaw crusher, a small gyratory crusher, rolls, sample grinder, a magnetic separator, and a small air compressor.

The machinery is driven by seven separate motors, and any one part or all of it can be operated at will, permitting experimental studies and tests of individual machines or groups of machines, or of an entire process, as occasion may require. The entire plant is thus flexible and enables combinations of processes in order to determine the best method to pursue in the treatment of gold and silver ores, both free milling and sulphides, by amalgamation and cyanide processes, and of lead, copper, zinc, iron ores, etc., and of coals, by coarse and fine concentration.

Owing to the prominence which flotation methods have assumed in ore concentration, a special department of the main laboratory has been equipped for this work, and four types of testing machines have been installed, together with the necessary equipment of motors, etc., for their operation.

The laboratory houses also the following equipment: large and small size Ingersoll-Rand rock drills, Stoper and Jack-hammer drills, an Ingersoll-Rand pick machine for coal mining, a Water-Leyner rock drill, a Sullivan hand-power diamond drill machine, and a Temple-Ingersoll electric-air drill. There are also a full size mine car, a section of track on steel ties, and several sets of steel mine timbers.

The laboratory has been named by the Trustees of the University "The Eckley B. Coxe Mining Laboratory" in memory of Eckley B. Coxe, who was universally recognized as a pioneer and a leader in the profession of mining engineering in this country, an active friend and valued Trustee of the University from its early days until his death. The Engineering and Mining Laboratories of Lehigh University, bearing the names of John Fritz and Eckley B. Coxe, record the friendship and close association of these two great engineers in their life-time, and their active interest in Lehigh.

CHRISTMAS HALL

Christmas Hall has historic interest as the first building of Lehigh University. It was originally a church, which was purchased from the Moravian Congregation. In the earliest years of the University it contained a chapel, lecture rooms and students' dormitory. After Packer Hall was completed in 1868, Christmas Hall and Saucon Hall were utilized as students' dormitories and mess hall up to 1885. For many years thereafter Christmas Hall was used by the Departments of Latin, Greek and Modern Languages.

The building is now largely devoted to the Department of Military Science and Tactics. There are class-rooms on the first floor, class-rooms and office on the second floor, and a lecture room and office on the third floor.

The offices of the Secretary of the American Electrochemical Society are in the west end of Christmas Hall.

SAUCON HALL

Extensive alterations to Saucon Hall were made in 1896, adapting it to the needs of the Department of English. It

contains a study and a recitation room for each instructor, a lecture hall seating 200 persons, and a large room on the ground floor which has been fitted up for the use of the literary societies, with committee rooms adjoining.

COPPÉE HALL

Coppée Hall, formerly the Gymnasium, was completely renovated in 1913 to adapt it to the needs of the Department of Arts and Science. On the first floor is a large lecture room, the office and recitation rooms of the Department of Economics and accounting rooms for instruction in Business Administration. On the second floor are the offices and recitation rooms of the Departments of Latin, Greek, German, Romance Languages, Philosophy and Education. The Psychological Laboratory, also situated on the second floor, is equipped for elementary instruction and experimentation in the psychology of sense and movement. On the third floor are the library and seminar room of the Department of Arts and Science, also a large room for a museum and art gallery.

SAYRE OBSERVATORY

By the liberality of the late Robert H. Sayre, one of the Trustees of the University, an Astronomical Observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

The Observatory contains an equatorial telescope by Alvin Clark, of six inches clear aperture and of eight feet facus; a zenith telescope, by Blunt; a superior astronomical clock, by William Bond & Son; a meridian circle; a prismatic sextant, by Pistor and Martins; and an engineer's transit and a sextant, by Buff and Buff.

Students in practical astronomy receive instruction in the use of the instruments and in observation.

The land upon which the Observatory stands, consisting of seven acres adjoining the original grant, was presented to the University by the late Charles Brodhead, of Bethlehem.

Sayre Observatory Annex

Sayre Observatory Annex contains a modern zenith telescope of four and one-half inches clear aperture equipped with electric illumination. The building and instruments were presented to the University by the late Robert H. Sayre in 1903.

Observations secured with this instrument are for the purpose of investigating the Variation of Latitude.

THE PACKER MEMORIAL CHURCH

The Packer Memorial Church, in which daily chapel exercises are held, was the munificent gift of the late Mrs. Mary Packer Cummings, daughter of the founder of the University. It was built in 1887 and is one of the largest churches in the State. During 1909-10 it was thoroughly renovated; the walls were newly frescoed, new stained glass windows put in place, and electric lights installed. These improvements were made possible by the continued generosity of the donor, Mrs. Cummings.

THE UNIVERSITY LIBRARY

The Library building was erected by the founder of the University in 1877, at a cost of $100,000, as a memorial to his daughter, Mrs. Lucy Packer Linderman.

The building is semi-circular with a façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior there is a reading room 40 by 50 feet from which radiate book cases extending from floor to ceiling; two galleries afford access to the upper cases. Shelf room is provided for one hundred and sixty thousand volumes. One hundred and fifty thousand volumes are now upon the shelves. The list of periodicals numbers about four hundred.

The Library is open from 8 A.M. to 6 P.M., except on Sundays and holidays.

The free use of the Library, with the privilege of taking out books, is offered to students of every department on presentation of their registration cards. The use of the books and of the periodicals within the building is free to all persons. Resident graduates of the University have the full use of the Library on payment of three dollars annually. Persons pursuing systematic investigation in any study may be allowed the free use of the Library for a period not exceeding three months without fee. At the discretion of the Director, a deposit may be required when books are issued.

The Eckley B. Coxe Memorial Library

In memory of Eckley B. Coxe, who was for many years a Trustee of the University and who was profoundly interested in its welfare, Mrs. Coxe presented to the University his technical library, consisting of 7727 volumes, together with 3429 pamphlets. As the working library of a man who was remarkable as well for the breadth of his culture as for the

extent and thoroughness of his acquaintance with the whole field of applied science, this addition to the resources of the University possesses the greatest value for all professional students.

TAYLOR HALL

Taylor Hall, the gift of Mr. Andrew Carnegie, is a commodious concrete dormitory situated in the University Park, south of Packer Hall. It accommodates 137 students. There are suites of three rooms, (a study and two adjacent bed rooms,) for two occupants, and a few single rooms. The building was named Taylor Hall by Mr. Carnegie in honor of Mr. Charles L. Taylor, his former partner in business, a graduate of the University in the Class of 1876 and a Trustee of the University. The rates for the suites of rooms are $100 a year for each occupant. The single rooms are $80 a year.

PRICE HALL

Price Hall furnishes dormitory accomodation for thirty-four students. It is named in honor of Dr. Henry R. Price, an alumnus of the University of the Class of 1870, President of the Board of Trustees.

Applications for rooms in the dormitories should be filed with the Bursar.

DROWN MEMORIAL HALL

Drown Memorial Hall is a memorial to the late Thomas Messinger Drown, LL.D., President of the University from 1895 to 1904. The building was erected by his friends and the alumni of the University and is devoted to the social interests of the University students. It contains study, reading, conversation, and chess rooms, an assembly hall, and the offices of the Alumni Association, the Young Men's Christian Association, the college publications, the dramatic and musical organizations. It also accommodates the Supply Bureau, conducted by the University, the purpose of which is to furnish books, stationery and supplies to the students at reasonable prices. The profits of the Supply Bureau are applied to the upkeep of Drown Memorial Hall.

The office of the Bursar is in Drown Memorial Hall.

THE COLLEGE COMMONS

The Commons was erected in 1907 to furnish a place where students might obtain wholesome food at cost. There are accommodations for four hundred students. The present rates for table board are $30 for thirty consecutive days.

TAYLOR GYMNASIUM AND FIELD HOUSE

In 1913 Mr. Charles L. Taylor, a graduate of the University of the Class of 1876 and a member of the Board of Trustees, donated to the University the funds required for the erection of a gymnasium and a field house.

Taylor Gymnasium is situated at the extreme east end of the grounds of the University, adjoining the athletic field. The building is 222 feet long by 73 feet wide. On the ground floor at the north end is located the game room, 93 by 70 feet, used for basketball and wrestling. The game-room is surrounded by a gallery for spectators. The main gymnasium floor measures 90 by 70 feet. Other rooms in Taylor Gymnasium are the offices and measuring room of the Department of Physical Education, a large trophy room, basketball and handball courts, fencing, boxing and wrestling rooms, and locker rooms with accommodations for the entire student-body.

The gymnasium is equipped with all modern appliances for recreative and corrective exercises, also with apparatus for calisthenic and other gymnastics, both for individual and for class work.

In addition to numerous hot and cold shower baths, adjoining the locker rooms is a swimming pool, 75 by 25 feet, with a depth from 4½ to 9½ feet. The capacity of the swimming pool is 95,000 gallons.

Adjoining the gymnasium and the stadium is the Taylor field house. It is two stories in height, and has dressing rooms, lockers and shower baths for visiting and Lehigh teams, and also rooms for medical attention to athletes.

TAYLOR FIELD

An athletic field of more than nine acres in area is provided by the University for the accommodation of students who participate in the various outdoor sports. The Stadium is located on the north side, or lower level, and provides football and baseball fields. It is surrounded by concrete stands having a seating capacity for more than 12,000 spectators. On the upper level there are practice fields for football, baseball, lacrosse and soccer, also a quarter mile track and a 220-yards straightaway, furnishing ample room for exercise by the entire student body. During the winter months a wooden outdoor running track, twelve laps to the mile is provided.

A cage with 60 by 120 feet floor space affords facilities for indoor baseball, lacrosse, and track and field sports practice.

All athletic sports are under the direction and oversight of the Professor of Physical Education, who is aided by an Athletic Committee composed of alumni and students, members of the Faculty, a member of the Board of Trustees, and the President of the University.

SAYRE PARK

A development of the mountain side of the University grounds was effected through the donation to the University in 1900 of the sum of $100,000 by the children of the late Robert H. Sayre to be applied and used in the development of Sayre Park as a memorial to their father. Mr. Sayre was a Trustee of the University from its foundation in 1866 to his death in 1907. He acted for years as President of the Board of Trustees, and as Chairman of the Executive Committee of the Board, and his services to Lehigh were constant and great.

THE ARBORETUM

The Arboretum is a tract of about eleven acres added in 1909 to the upper end of Sayre Park. It was established by a lover of Forestry and a friend of the University as a tree nursery for the purpose of furnishing illustrative specimens of American trees, and of cultivating trees and shrubs for the beautifying of the Park. All of the more important species of North American trees are to be found in the University Park and the Arboretum. Adjoining the Aboretum a tract of seven acres has been planted with a variety of indigenous trees as an exhibition growth of tree culture.

THE UNIVERSITY MUSEUMS

The University Museums include large collections illustrating various branches of Chemistry, Metallurgy, Geology, Mineralogy, Zoölogy and Archæology.

The Metallurgical Cabinet contains specimens illustrating the various processes for obtaining the more common metals.

The Zoölogical collections include the Packer collection of recent shells and the Werner collection of American birds. The latter contains over three hundred and fifty species. In most cases, in addition to the adults, specimens in different plumages as well as the nests and eggs are represented.

The Geological and Mineralogical Museums are housed in the west end of Williams Hall, and contain the Roepper and Keim mineral collections, collections of fossils, specimens of

ore from mining districts, and extensive series of rocks which illustrate the type occurrences in different parts of the world.

The Cummings Archæological Cabinet has three thousand specimens and includes Dr. Stubb's collection of Indian relics, weapons and utensils.

UNIVERSITY LECTURES

From time to time during the University year, distinguished men in science, letters, art and business give lectures before the student body.

HONORARY SCHOLARSHIP SOCIETIES

PHI BETA KAPPA. Students in the College of Arts and Science and the College of Business Administration who up to the middle of the Senior year maintain high scholarship may be elected to membership, also a limited number of technical students whose work in philosophical, scientific, and language studies is of high grade.

TAU BETA PI. Students in the College of Engineering who up to the middle of the Junior year maintain high scholarship may be elected to membership.

SOCIETIES OF THE COLLEGE OF ENGINEERING

An adjunct of value in promoting professional spirit in the College of Engineering is furnished by the departmental societies,—volunteer organizations of students who meet monthly to present papers, to discuss engineering topics and, from time to time, to hear addresses by invited engineers and scientists of note.

The first of these organizations historically was the Chemical Society, organized in 1871. The original Engineering Society, open to all technical students of the Uiversity, was started in 1872. From 1885 to 1889 it issued quarterly numbers of *The Journal of the Engineering Society of Lehigh University*, containing contributions by members, alumni and others. Many of the papers read before this Society from 1890 to 1893 were published in the *Lehigh Quarterly* of those years.

Independent societies were formed in 1900 by students in the Departments of Civil Engineering and Mechanical Engineering. The Electrical Engineering Society, founded in 1887, was reorganized in 1901. The Mining and Geological Society began in 1904, the Metallurgical Society in 1917.

THE ARTS AND SCIENCE CLUB

The Arts and Science Club is the student society of the College of Arts and Science. It was founded in 1905, with the aim of promoting literary and cultural interests in the University. Students in all courses are eligible for membership. The programs of meetings include papers by members, discussions led by teachers in the College, and occasional talks by scholars from other institutions.

THE Y. M. C. A. OF THE UNIVERSITY

The Christian Association is a voluntary organization of the students for the promotion of the religious, moral, and social life of the University. It was organized April 18, 1890, and on October 11, 1890, united itself with the Intercollegiate Young Men's Christian Association. The movement is distinctly for and by students, all the officers, with the exception of the General Secretary, being chosen from the student-body. The General Secretary is Mr. J. Mark Frey, whose office is in Drown Memorial Hall.

PUBLIC WORSHIP

Morning prayers are held in Packer Memorial Church at 7:45 a.m. on every week day except Saturday. Attendance of students is required.

FOUNDER'S DAY

On the first Saturday of October of each year, commemorative exercises are held in honor of the founder of the University. On Saturday, October 2, 1920, the forty-first Founder's Day was celebrated. The oration of the day was delivered by the Rt. Rev. James De Wolf Perry, Bishop of Rhode Island.

UNIVERSITY SUNDAY

The University sermon is preached on the Sunday before University Day. The Rt. Rev. Wilson R. Stearly, D.D., Bishop Coadjutor of Newark, was the preacher on Sunday, June 13, 1920, in the Packer Memorial Church.

HONOR SYSTEM

The Honor system is in force at Lehigh University, having been adopted by the unanimous action of the student-body.

GRADUATING THESES

Theses, when required, are accompanied by drawings and diagrams, whenever the subjects need such illustration. The originals are kept by the University, as a part of the students'

record, for future reference, but copies may be retained by students, and may be published, permission being first obtained from the Faculty.

UNIVERSITY DAY

University Day is the close of the collegiate year. On this day graduation exercises are held at which an address is given by a representative of the Alumni Association, prizes and honors are awarded, and degrees are conferred.

The program of the exercises on June 15, 1920, was as follows:

MUSIC

PRAYER

ALUMNI ADDRESS

RAYMOND WALTERS, B.A., '07, M.A., '13

ANNOUNCEMENT OF PRIZES AND HONORS

The Wilbur Scholarship of $200,

ERNEST PAUL GANGEWERE, of Chattanooga, Tenn.

First in rank in the Sophomore Class.

The John B. Carson Prize of $50 for the best thesis in the Civil Engineering Department,

CHARLES FREDERICK RUFF, of Philadelphia, and

JEROME JOHN MIELDAZIS, of Shenandoah, jointly.

The Alumni Prizes of $25, for first honor men in the Junior Class in various departments,

Civil Engineering,

EDMUND WARREN BOWDEN, of Camden, N. J.

The Wilbur Prizes of $10 for excellence in the studies of the Sophomore year,

In Mathematics,

EDWIN LOUIS REYNOLDS, of Bethesda, Md.

In Physics,

GEORGE FREDERICK ADELBERT STUTZ, of Washington, D.C.

The Wilbur Prizes of $15 and $10, for excellence in the studies of the Freshman year,

In Mathematics,

First: ROBERT GAIR PFAHLER, of Wilkes-Barre.

Second: HENRY CONRAD BIEG, of Philadelphia.

In English,

CHARLES HECK MILLER, of Wilkes-Barre.

In German,
CLEMENT SOLOMON SCHIFREEN, of Catasauqua.
In French,
PHILIP HALSTEAD HARTUNG, of Newport, R. I.
The Price Prize in Freshman Composition, $25,
WILBERT DAVID MUSCHLITZ, of Bethlehem.

SENIOR HONORS

College of Arts and Science,
First: HOWARD STOLPP BUNN, of Elkins Park.
Second: CLYDE REUBEN FLORY, of Edelman.
College of Engineering,
Civil Engineering Course,
First: CHARLES FREDERICK RUFF, of Philadelphia.
Second: HAROLD HODGKINS DEWHIRST, of Washington, D.C.
Mechanical Engineering Course,
First: JULIUS HERMAN SPALDING, of Pottsville.
Second: ROBERT JOSEPH OTT, of Bethlehem.
Metallurgical and Mining Engineering Courses:
First: WILBUR REINOEHL HECK, of Ocean Grove, N. J.
Second: AUGUST MAX KUHLMANN, of Washington, D. C.
Electrical Engineering Course,
First: JOSEPH HERMAN, of Northampton.
Second: FREDERICK GARNER MACAROW, of Hazleton.

JUNIOR HONORS

College of Arts and Science,
First: MICHAEL CORNELIUS SCHRADER, of Bethlehem.
College of Engineering,
Civil Engineering Course,
First: EDMUND WARREN BOWDEN, of Camden, N. J.
Second: CARL RICHARD BERNER, of Pottsville.
Mechanical Engineering Course,
First: SMIE KWEI CHOU, of Patung, Hupeh, China.
Second: EDWARD ADOLPH COPPERSMITH, of Egypt.

SOPHOMORE HONORS

In Mathematics,
First: ERNEST PAUL GANGEWERE, of Chattanooga, Tenn.
Second: EDWIN LOUIS REYNOLDS, of Bethesda, Md.
Third: CHUNG-FA CHEN, of Yo-Wan-Kei, Changsha, China.

In Physics,

First: George Frederick Adelbert Stutz, of Washington, D. C.

Second: Charles Forbes Silsby, of Washington, D. C.

FRESHMAN HONORS

In Mathematics,

First: Robert Gair Pfahler, of Wilkes-Barre.

Second: Henry Conrad Bieg, of Philadelphia.

In English,

Charles Heck Miller, of Wilkes-Barre.

In German,

Clement Solomon Schifreen, of Catasauqua.

In French,

Philip Halstead Hartung, of Newport, R. I.

Degrees in course were then conferred by the President of the University as follows:

MASTER OF ARTS

Arthur L. De Lozier, B.A., (*Ashland College*),	Allentown.
William M. Tinker, B.A., (*Yale University*),	Allentown.

MASTER OF SCIENCE

John Edmiston Bauman, A.B., C.E., (*Muhlenberg College, Lehigh University*),	Allentown.
Dale S. Chamberlin, Ch.E., (*University of Michigan*),	Bethlehem.
Ovid Wallace Eshbach, E.E., (*Lehigh University*),	Bethlehem.
John G. Schumaker, A.B., (*Muhlenberg College*),	Allentown.
Herbert Homer Wentz, B.S., (*Muhlenberg College*),	Allentown.

BACHELOR OF ARTS

William Andrew Beck, Jr.,	Englewood, N. J.
Howard Stolpp Bunn,	Elkins Park.
Robert Schwartz Cope,	Bethlehem.
Boyd Ross Ewing, Jr.,	Allentown.
Hobart Amory Farber,	Northampton.
Clyde Reuben Flory,	Edelman.

James Cullen Ganey,	Bethlehem.
Philip Randolph Hills,	Mill Hall.
William Alfred Kreidler,	Bethlehem.
William David Maginnes,	New York, N. Y.
Mercer Brown Tate, Jr.,	Harrisburg.

BACHELOR OF SCIENCE

Preston Clayton Barthol,	Bethlehem.
Sheldon Vanderbilt Clarke,	Williamsport.
Arthur William DuBois,	Coudersport.
Jacob Allen Gardy,	Doylestown
Harold Frederick Golding,	Trenton, N. J.
Lawrence Hartman Harwi,	Bayonne, N. J.
John Myers Howard, Jr.,	Latrobe
Leonard Phillips Leverich,	Brooklyn, N. Y.
Arthur Wyndham Lewis,	Martin's Ferry, O.
Joseph Geggus Obert,	Lehighton

CIVIL ENGINEERING

William Raymond Allgaier,	Philadelphia.
John Sterrett Barefoot,	Milroy.
Edwin Booth,	Carbondale.
Alvin Newton Bugbee,	Trenton, N. J.
Peter Aloysius Carr,	Freeland.
Harold Hodgkins Dewhirst,	Washington, D. C.
Fernando Gonzales,	Torreon, Mexico.
Richard Holmes Grubbs,	Baltimore, Md.
Philip Conrad Hammond,	Bridgeport, Conn.
Harry G. Levy,	Hazleton
Oscar Ezra LeWine,	Atlantic City, N. J.
Cyril Glennon Melville,	Harrisburg.
Jerome John Mieldazis,	Shenandoah.
Joseph Shikri Naame,	Atlantic City, N. J.
Milnor Peck Paret, Jr.,	Lake Charles, La.
Joseph Alfred Reinhardt,	Brooklyn, N. Y.
Leonard Edward Ruf,	Philadelphia.
Charles Frederick Ruff,	Philadelphia.
Joseph Spagna,	Avon, Mass.
Edward Stotz, Jr.,	Pittsburgh.
James Moser Straub,	Canonsburg.
John Irving Timmons,	Snow Hill, Md.
August Hans Wagener,	Ellicott City, Md.
John Harold Wagner,	Harrisburg.

MECHANICAL ENGINEER

Engelbert Henry Baderschneider,	Monongahela.
John Beard,	Germantown.
Russell Sylvester Bellman,	Louisville, Ky.
John George Bergdoll, Jr.,	York.
Jacob Ariel Bishop, B.A., (*Lehigh University*),	Chambersburg.
William Arthur Carr,	Washington, D. C.
Russell William Herbert Danzer,	Bethlehem.
Edward Wynne Estes,	Bethlehem.
Arthur Randolph Evans,	Freeland.
Edward Logan Forstall,	Rosemont
Joseph Lewis Geiger,	Scarletts Mills.
Alfred William Glaser,	Baltimore, Md.
Eugene Dewey Heimbach,	Renovo.
Clarkson Toms Hunt,	Lansdowne.
Ralph Johnson Knerr,	Claussville.
Randolph Osgood Lewis,	Washington, D. C.
Audato Lorenzo Muñoz	Santa Barbara, Honduras.
Edgar Franklin Muth,	Northampton
Robert Joseph Ott,	Bethlehem.
Lawrence Frank Reed,	Orwigsburg.
William Henry Schlasman,	Reading.
Alfred Elwood Morton Shafer,	Lehighton.
Julius Herman Spalding,	Pottsville.
Robert Charles Weishaupt,	Lancaster.

METALLURGICAL ENGINEER

John Gordon Bell,	Canton, O.
Robert Emerson Brown,	Butler.
Beale Bordley Davidson,	Elizabeth, N. J.
Robert Brodhead Honeyman,	Brooklyn, N. Y.

ELECTROMETALLURGIST

Elwood Maxwell Allan,	Jermyn.
Maxwell Jacobs Brooks,	Niagara Falls, N. Y.
Gennero Della Croce,	Freeland.
William Christman Dorsam,	Brooklyn, N. Y.
John Beaver Heilman,	Lebanon.
William James Knerr,	Allentown.
August Max Kuhlmann,	Washington, D. C.
Milton Joseph LeRoy,	Syracuse, N. Y.
Arnold Dolder Spillman,	Bethlehem.

Clarence William Warner,	Newark, N. J.
Marmaduke Revenaugh Wolfe,	New York, N. Y.
William Henry Simmons Youry,	Newark, N. J.

ENGINEER OF MINES

Lester Nathaniel Chapman,	Wollaston, Mass.
George A. Ganter,	New York, N. Y.
Wilbur Reinoehl Heck,	Ocean Grove, N. J.
Joseph Austin Holmes, 2nd,	Washington, D. C.
John Donald McCarthy,	Bethlehem.
Nathan Mathag,	New Haven, Conn.
Joseph Lewis Rosenmiller,	York.
Harry Suydam Saxman,	Latrobe.
Howard Lee Wey,	Bristol, Conn.
Chun Tai Yen,	Kiangsi, China.

ELECTRICAL ENGINEER

Homer Allison Bachert,	Bethlehem.
August Concilio,	Newton, N. J.
Darcy Matthew George,	Nazareth.
Joseph Herman,	Northampton.
Solomon Hoffman,	Baltimore, Md.
Frederick Garner Macarow,	Hazleton.
Benjamin Ross Nevins,	Tamaqua.
Norman Albert Newell,	West Hoboken, N. J.
Frederick Meredith Porter, (*Lehigh University*),	York.
Ricklef Allen Reid,	Glen Ridge, N. J.
John Emil Schmich,	Bethlehem.
William Blottenberger Shirk,	Lebanon.
Lloyd Moser Smoyer,	Allentown.
Joseph Anthony Wensk,	Baltimore, Md.
Albert James Wick,	Washington, D. C.

CHEMICAL ENGINEER

Fred Peter Diener,	Allentown.
Francis John George Duck, B.S., (*St. Thomas College*),	Scranton.
George Henry Erwin,	Bethlehem.
Philip David Greenstein,	Bridgeport, Conn.
William Hoppe Hunton,	Philadelphia.
Harry Karton,	Philadelphia.
Rollin Reuben Keim,	Bethlehem.

John Henry Mersfelder, Jr.,	Newark, N. J.
Edward Allen Mooers,	Elmira, N. Y.
Arthur Heckford Randall,	Bloomfield, N. J.
Harry Charles Rice,	Hazleton.
George Stanley Scott,	East Mauch Chunk.
Harold DeWitt Smith,	Bayonne, N. J.
Howard Greenwald Sommers,	Allentown.
Philip Subkow,	Bethlehem.
Aaron Jesse Sugar,	Norfolk, Va.
John Hermon Terry, Jr.,	Edgewater Park, N. J.
James Stanley Thompson,	Warehouse Point, Conn.
Robert Alexander Wilbur, Jr.,	Elmira, N. J.

HONORARY DEGREE

MASTER OF ARTS

Warren Abbott Wilbur,	Bethlehem.

SCHOLARSHIPS, FELLOWSHIPS, AND PRIZES

THE WILBUR SCHOLARSHIPS

The Wilbur Scholarship was founded in 1872 by the late E. P. Wilbur and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

THE HARRY S. HAINES MEMORIAL SCHOLARSHIPS

Mrs. Henry S. Haines, of Savannah, Georgia, established in 1889 a scholarship of the annual value of $200 as a memorial to her son, Henry Stevens Haines, M.E., a member of the Class of 1887. This scholarship is devoted to the support at Lehigh University, throughout his scholastic career, of one student in the Course of Mechanical Engineering.

THE FRED. MERCUR MEMORIAL FUND SCHOLARSHIPS

Friends of the late Frederick Mercur, of Wilkes-Barre, Pennsylvania, General Manager of the Lehigh Valley Coal Company, desiring to establish a memorial of their friendship and esteem, and to perpetuate his memory, contributed and placed in the hands of the Trustees a fund called "The Fred. Mercur Memorial Fund," sufficient in amount to insure the award of three scholarships for free tuition in the University.

THE JOSEPH MANN PRICKITT SCHOLARSHIP

Mr. and Mrs. Cooper H. Prickitt, of Burlington, New Jersey, established, in April, 1919, a scholarship, to be known as the Joseph Mann Prickitt Scholarship, in memory of their son,

Joseph Mann Prickitt, of the Class of 1917, who died on March 10, 1916.

This scholarship is of sufficient amount to cover expenses for tuition, fees and books. It is the expressed wish of the donors that the scholarship be awarded to graduates of the Burlington, New Jersey, High School on the nomination of the Principal of that school, subject to the approval of the President of the University, or in case of no nomination from that school that the award be made to deserving students from other places.

THE ECKLEY B. COXE MEMORIAL FUND

In memory of the late Eckley B. Coxe, Trustee of the University, Mrs. Coxe has established a fund, amounting to $30,000, the interest of which is used, under the direction of the Trustees of the University, and subject to such regulations as they may adopt, for the assistance of worthy students requiring financial aid.

THE FRANK WILLIAMS FUND

Frank Williams, E.M., of Johnstown, Pennsylvania, a graduate of the course in Mining and Metallurgy of the Class of 1887, who died October, 1900, bequeathed to the University the greater part of his estate, now amounting to over $120,000, to found a fund, the income of which is lent to deserving students. At present the larger part of this income is devoted to certain life tenants under Mr. William's will. After their death the entire income will be available.

THE DUPONT FELLOWSHIP

In June, 1918, E. I. duPont de Nemours and Company, for the purpose of encouraging the study of Chemistry, offered an annual scholarship of $350 to be awarded to a senior student or graduate student in the Department of Chemistry and Chemical Engineering. For the collegiate year, 1920-1921, the amount was increased to $750 for the establishment of a fellowship.

THE GEORGE D. CALLENDER FELLOWSHIP

The George D. Callender Fellowship for the promotion of research in chemistry is a gift of $1500 for the collegiate year, 1920-1921, bestowed by an anonymous friend of the late George D. Callender, a chemist who died in Chicago in 1914 while associated with the donor of the scholarship. Mr. Cal-

lender was a native of Linlithgow, Scotland, and was graduated from the chemistry department of Glasgow University.

WILBUR PRIZES

A fund was established by the late E. P. Wilbur for distribution in prizes as the Faculty shall determine. This fund yields an annual income of $100.

THE PRICE PRIZE FOR ENGLISH COMPOSITION

Dr. Henry R. Price, an alumnus and Trustee of the University, established in 1898 an annual prize of the value of $25, to be awarded in June to that member of the Freshman Class who shall write the best essay on a topic in English Literature assigned by the head of the Department of English not later than the beginning of the second term in each year. Especial stress will be laid upon clearness of thought and force of expression.

Students must signify in writing their intention of competing not later than the first of April.

The subject for the prize essay in June, 1921, will be: "Literature in New York Before 1870."

THE JOHN B. CARSON PRIZE

An annual prize of $50 was established in 1909 by Mrs. Helen C. Turner, of Philadelphia, Pennsylvania, in memory of her father, John B. Carson, whose son, James D. Carson, was a graduate of the Civil Engineering Department of Lehigh University in 1876. It is awarded for the best thesis in the Civil Engineering Department.

WILLIAM H. CHANDLER PRIZES IN CHEMISTRY

Four annual prizes in chemistry of $25 each were established in 1920 by the gift of Mrs. Mary E. Chandler, of Bethlehem, widow of Dr. William H. Chandler, who was Professor of Chemistry in Lehigh University from 1871 until his death in 1906. In memory of Dr. Chandler the Faculty named the prizes "The William H. Chandler Prizes in Chemistry." Awards are made at the commencement exercises in June to the four members of the Freshmen, Sophomore, Junior and Senior classes deemed by the Faculty worthy to receive them.

THE ALUMNI ASSOCIATION

The Alumni Association, which has been in existence since 1876, was incorporated in 1917 under the name The Alumni Association of the Lehigh University, Inc. The Alumni Sec-

retary, who devotes all of his time to Association affairs, is Walter R. Okeson, '96, whose offices are in Drown Memorial Hall. Mr. Okeson edits the *Lehigh Alumni Bulletin*, a news publication published monthly from October to June, inclusive, and the *Alumni and Student List*. An appointment bureau is maintained by the Association.

The officers of the Alumni Association for 1920-21 are:

President, Charles D. Marshall, '88, of Pittsburgh.
Vice-President, H. D. Wilson, '01, of Pittsburgh.
Vice-President, Robert Farnham, '99, of Philadelphia.
Treasurer, Alan C. Dodson, '00, of Bethlehem.
Secretary, Walter R. Okeson, '96, of Bethlehem.
Archivist, Preston A. Lambert, '83, of Bethlehem.

Honorary Alumni Trustees: Franklin Baker, Jr., '95, of Philadelphia; Henry H. Scovil, '00, of Pittsburgh; Homer D. Williams, '87, of Pittsburgh, and William C. Dickerman, '96, of New York.

The following are the local alumni clubs: New York Lehigh Club, Philadelphia Lehigh Club, Pittsburgh Lehigh Club, Chicago Lehigh Club, Washington Lehigh Club, Detroit Lehigh Club, Northeastern Pennsylvania Lehigh Club (Scranton and Wilkes-Barre), Maryland Lehigh Club (Baltimore), Lehigh Club of New England (Boston), Intermountain Lehigh Club (Salt Lake City, Utah), Lehigh Club of Central Pennsylvania (Harrisburg), Lehigh Club of Northern New York (Schenectady), Lehigh Club of Northern Ohio (Cleveland), Lehigh Club of Southern New England (Hartford), Lehigh Club of Western New York (Buffalo), Southern Anthracite Lehigh Club (Pottsville), Southwestern Lehigh Club (St. Louis), Lehigh Home Club (Bethlehem), Lehigh Club of China (Wuchang), Lehigh Club of Cuba (Havana).

ALUMNI PRIZES

By a resolution of the Alumni Association of September 21, 1900, the Alumni Scholarship Fund, which was originally designed to help poor students, was with the consent of the contributors diverted from this purpose and the income devoted to prizes to members of the Junior Class. In June, 1921, two prizes of $25 each will be awarded to the first honor men of the course in Mechanical Engineering and of the courses in Metallurgy and Mining Engineering. In sub-

sequent years the prizes will be awarded to the first honor men of the other technical courses in turn.

ALUMNI PRIZES FOR ORATORY

The Alumni Association of Lehigh University established in 1882 annual prizes for excellence in oratory, amounting to $50.

Regulations

1. The contest shall be held on the 22nd day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second prize of $15, and a third prize of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the orations shall be announced at the beginning of the first term of every year, and upon one of these each competitor shall write an oration not to exceed 1200 words, taking about eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do—should they be sufficient in number—the best six shall be chosen and their envelopes opened. The others shall be returned to the addresses given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors whose orations shall have been approved, and the awards shall be made by a majority of these judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

The annual contest in Oratory for the Alumni Prizes was held on February 21, 1920, with the following competitors:

Robert Dominick Billinger, of Shenandoah, Pennsylvania.

Edmund Warren Bowden, of Camden, New Jersey.

Benjamin Ettelman, of Philadelphia, Pennsylvania.

Abraham Fleischer, of Baltimore, Maryland.

Willis Jones Parker, West Pittston, Pennsylvania.

The first prize was awarded to Mr. Bowden, the second to Mr. Billinger, and the third to Mr. Ettelman.

The judges were William A. Lambert, '95; Walter R. Okeson, '96, and Dr. Arthur D. Thaeler.

WILLIAMS PRIZES IN ENGLISH

Professor Edward H. Williams, jr., an alumnus of the University, a graduate of the Class of 1875, established in February, 1900, prizes amounting annually to three hundred and thirty-five dollars for excellence in English Composition and Oratory. The conditions of the endowment are as follows:

Sophomore Composition Prizes

1. At the beginning of each term the Sophomore Class shall be divided into two sections alphabetically and to that student in each section who, at the end of a term, and of each term, shall receive the highest rank in English Composition during that term shall be awarded the "First Sophomore Composition Prize" of ten dollars, and to that student in each section as aforesaid who shall receive the next highest rank in the same subject shall be awarded the "Second Sophomore Composition Prize" of five dollars. In each year there will be offered four first and four second prizes—a total of sixty dollars.

If more than one student shall receive the highest rank in any section, the amount of the two prizes shall be added together and the sum—fifteen dollars—shall be equally divided between them, and no second prize shall be offered in that section. If more than one student shall receive the next highest rank in any section when there is but one contestant for the first prize, the second prize shall be equally divided between the two having the second rank.

Senior Premiums

2. The Faculty shall publish within one month of the end of the University year a list of subjects for dissertations, selected from English Literature and Economics, entitled Subjects for Senior Premiums. To this list shall be appended a date near the first of January following—to be determined upon by the Faculty—when the contest shall be declared closed and the dissertations shall become due.

From the above list any member of the Senior Class may select a subject and write thereon a dissertation, whose length shall be prescribed by the Faculty, and shall send the same anonymously, but marked for identification, as the Faculty may direct, to the Secretary of the Faculty before the date aforesaid.

The Faculty, or its committee, shall meet on the above date and at subsequent adjourned meetings, and, first, having determined upon a standard of excellence which each and all dissertations must reach in order to be admitted to the following competition, shall examine the dissertations submitted to them and admit those which reach the above standard. In case none are up to the standard, and are admitted they shall declare the contest closed for that year, and no prizes shall be awarded.

If one or more dissertions are admitted as aforesaid, the Faculty, or its committee, shall arrange them in the order of their literary merit and soundness of their reasoning, and the six highest in this arrangement shall be retained and all others returned as directed by the writers, who shall remain unknown. The names of the successful

writers shall be ascertained and they shall be required to recast their dissertations in the form of an oration, and to speak the same in public at such time during the Commencement Week as the Faculty shall determine.

The Faculty, or its committee, shall be the judges of excellence in the speaking, and shall award to that Senior student who shall speak his oration in the best manner, the Senior Gold Medal, of the value of one hundred dollars, or, at his option, one hundred dollars in gold. They shall award to the other five speakers the five Senior Premiums of ten dollars each.

Graduate Prize

3. At the end of the University year, during Commencement Week, the Faculty shall publish a second list of subjects for theses selected from English Literature, Economics, Mental and Moral Science, and similar subjects which require thought and application, and which must be of such a character that their mastery shall be accomplished only through considerable research and study.

From this list any member of the class just graduating; the Senior Class of the coming University year; a graduate of one year's standing whether in or out of residence, and a graduate of any class who may be, during the coming year, in actual residence and taking post-graduate work in the University, may select a subject and write thereon a thesis of not less than five thousand words and send the same to the Secretary of the Faculty, anonymously, but marked for identification as the Faculty may designate, before the date, which the Faculty shall select within one month before the next Commencement, and which date must appear on the above list.

The Faculty, or its committee, shall meet on this date, and at adjourned meetings thereafter, and, having first established a standard of excellence, which must, first, be a high one, and second, shall require on the part of the competitor ability in the plan, development, argument, and conclusion of the work, as well as literary merit in its composition and presentation, shall admit to the following competition only those who fully attain to the above required standard.

If none of the theses submitted shall have attained to the standard aforesaid, the competition shall be declared closed and the prize shall not be awarded.

To the author of that thesis which shall have been admitted to the competition, and which shall have been declared of the highest excellence, the Graduate Prize of one hundred and twenty-five dollars shall be awarded and presented on Commencement Day with the other prizes and awards of that day.

The successful thesis shall be the property of the University, but the author shall be allowed to retain one copy. Publication of the thesis by the author will only be permitted by vote of the Faculty. Such publication must, however, be entitled Graduate Prize Thesis of the Lehigh University.

The winner of a prize shall not be allowed to compete again.

Professor Williams has directed that the income derived from the endowment for the Williams Prizes shall be applied and used as follows:

1. All portions of said income remaining after the payment of all prizes awarded in any one year, shall be invested and added to the principal of said endowment.

2. If any prize shall, for any reason, be not awarded in any year, the sum thus unpaid shall be invested and added to the said principal.

3. If for any reason the amount of the income from said endowment shall fall below the total sum necessary to pay said prizes, the amounts of the individual prizes shall be proportionally reduced till their sum shall be equal to three-fourths of the said reduced income, and this three-fourths shall be used to pay them; the remaining one-fourth is to be invested and added to the said principal.

4. This investment of residues, as above said, shall continue till the principal of said endowment shall be sufficiently large to furnish an income at two per cent. interest, which will be sufficient to pay all said prizes now established.

5. When said principal shall be large enough to furnish the necessary sum to defray the said prizes, as stated in No. 4, the surplus income remaining after paying all the prizes awarded during the year shall be used by the President of the University to encourage oratory, debate, or any other object decided upon by the Faculty.

THE FRAZIER AND RINGER MEMORIAL FUND

This is a fund for the medical and surgical care of needy students, established in memory of Benjamin West Frazier, A.M., Sc.D., formerly Professor of Mineralogy and Metallurgy, and Severin Ringer, U.J.D., formerly Professor of Modern Languages and Literatures and of History, each of whom faithfully served Lehigh University for one-third of a century. The fund was started February 12, 1906, by the donation of thirteen thousand dollars by the late Robert H. Sayre. It is the hope and expectation of the friends of the University that this fund may, by other donations, be increased in time to amount to a sum sufficient to insure free medical and surgical attendance to all students of the University requiring such aid.

STUDENTS

B.A.—Bachelor of Arts.
Bus.—Business Administration.
C.E.—Civil Engineering.
Ch.E.—Chemical Engineering.
Chem.—Chemistry.
E.E.—Electrical Engineering.
E.M.—Mining Engineering.
El.Met.—Electrometallurgy.
M.E.—Mechanical Engineering.
Met.—Metallurgy.
N.E.—Ship Construction and Marine Transportation.

The names in the following lists include all the students who have registered and attended recitations at the University for the current year.

GRADUATE STUDENTS

	For Degree	Residence
Anderson, Harold Victor, B. Ch.E., (*University of Michigan.*)	M.S.,	Bethlehem.
Anderson, Rachel E., B.A., (*Wellesley College.*)	M.S.,	Easton.
Arnold, Herbert Franklin, A.B., (*Franklin and Marshall College.*)	M.A.,	Easton.
Bachman, Charles Clinton, A.B., A.M., (*Muhlenberg College.*)	M.A.,	Allentown.
Barthold, William Gregory, B.A., (*Lehigh University.*)	M.A.,	Bethlehem.
Bauman, John Edmiston, A.B., C.E., M.S., (*Lehigh University.*)	M.A.,	Allentown.
Beaver, Jacob Lynford, E.E., (*Lehigh University.*)	M.S.,	Bethlehem.
Billow, Milton Oscar, B.A., (*Lebanon Valley College.*)	M.A.,	Harrisburg.
Brockman, Charles Joseph, B.A., (*Lehigh University.*)	M.A.,	Nazareth.
Brunner, William Albert, B.A., (*Lebanon Valley College.*)	M.A.,	Harrisburg.
Buck, Leonard Jerome, E.M., (*Lehigh University.*)	M.S.,	Bethlehem.
Burke, James Michael, B.S., (*Lehigh University.*)	M.S.,	Akron, Ohio.
Carter, Wayne Hanley, B.S. (in Chem.), (*Lehigh University.*)	M.S.,	Bethlehem.
Concilio, August, E.E., (*Lehigh University.*)	M.S.,	Bethlehem.

Diefenderfer, Herbert H., B.S., M.S., South Amboy, N. J.
(*Pennsylvania State College.*)
Doan, Gilbert Everett, Ch.E., M.S., Annapolis, Md.
(*Lehigh University.*)
Frankenfield, Ira M., B.S., M.S., Coopersburg.
(*Muhlenberg College.*)
Friedlander, Sarah, B.A., M.A., Allentown.
(*Hunter College.*)
Fegley, Solon J., A.B., M.S., Allentown.
(*Lafayette College.*)
Glasier, J. Arthur, B.D., M.A., Bethlehem.
(*General Theological Seminary.*)
Grubb, Percy Lamar, B.A., M.A., Harrisburg.
(*Lehigh University.*)
Haussmann, Alfred Carl, B.A., M.A., Fox Chase.
(*Lehigh University.*)
Hess, Mary L., A.B., M.A., Hellertown.
(*Allentown College for Women.*)
Higgins, Emerson Corson, Jr., M.S., Tulsa, Okla.
B.S., (*Lehigh University.*)
Ho, Chee Kin, B.E.M., M.S., Hong Kong, China.
(*University of Illinois.*)
Hoch, Helena M., B.A., M.A., Bethlehem.
(*Moravian College for Women.*)
Ischinger, Robert H., B.D., M.A., Allentown.
(*Mt. Airy Lutheran Theological Seminary.*)
Jacobs, Homer Miller, Ph.B., M.A., Easton.
(*Lafayette College.*)
Jones, Ernest E., B.S., M.S., Palmerton.
M.S. (in Chem.), *Johns Hopkins University, University of Chicago.*)
Kamura, Heihachi, Met.E., M.S., Saga, Japan.
(*Meiji College of Technology, Japan.*)
Karsch, Carl Henry, A.B., M.A., Allentown.
(*University of Pennsylvania.*)
Kast, Bessie Edna, B.A., M.A., Harrisburg.
(*Wellesley College.*)
Lawall, Charles Elmer, Jr., E.M.,
(*Lehigh University.*) M.S., Allentown.
Lu, Chang-Chih, E.E., M.S., Canton, China.
(*Lehigh University.*)

McCullough, Herry Rath, A.B., M.A., Allentown.
(*Muhlenbedg College.*)
Marcks, Frederick Augustus, M.A., Nazareth.
B.A., (*Muhlenberg College.*)
Martin, Robert Earl, A.B., M.A., Bethlehem.
(*University of Indiana.*)
Rex, Barron P., Ph.B., M.S., Easton.
(*Lafayette College.*)
Ringleben, August A., A.B., M.A., Hazleton.
(*Ursinus College.*)
Schealer, Samuel Raymond, E.E., M.S., Bethlehem.
(*Lehigh University.*)
Sheaffer, Ira Lee, B.S., M.S., Northampton.
(*Muhlenberg College.*)
Shafer, Bentley Sayre, B.A., M.A., Asheville, N. C.
(*Lehigh University.*)
Shedd, Thomas C., Sc.B., M.S., Phoenixville.
(*Brown College.*)
Smull, Judson Gray, M.S., Bethlehem.
B.S. (in Chem.) (*Lehigh University.*)
(George D. Callender Fellow in Chemistry.)
Strunk, Elvira M., B.S., M.S., Changsha, Hunan, China.
(*Albright College.*)
Subkow, Philip, Ch.E., M.S., Bethlehem.
(*Lehigh University.*)
Tatnal, Edna Grace, A.B., M.A., Harrisburg.
(*Pennsylvania College for Women.*)
Ward, Arthur Thomas, El.Met., M.S., Bellefonte.
(*Lehigh University.*)
Weirbach, T. Mahlon, A.B., M.A., Allentown.
(*University of Michigan.*)
Wentz, Herbert Homer, B.S., M.S., Allentown.
(*Muhlenberg College.*)
Wetherhold, Ralph V., B.S., M.S., Allentown.
(*Muhlenberg College.*)
Yeager, Howard James, A.B., M.A., Emaus.
(*Franklin and Marshall College.*)
Zerfass, Elizabeth, A.B., M.A., Phillipsburg, N. J.
(*Randolph-Macon Women's College.*)
Ziegenfuss, Warren Allen, A.B., M.A., Allentown.
(*Muhlenberg College.*)

Bunn, Howard Stolpp, B.A., Ch.E., Elkins Park.
(*Lehigh University.*)
Cassler, George Williams, B.A., Ch.E., Hollsopple.
(*Susquehanna University.*)
Chang, Kin-Fang, B.A., Met., Shanghai, China.
(*St. John's University, Shanghai, China.*)
Elguin, Agustin Nazario, C.E., E.M., Santiago, Chile.
(*University of Chile.*)
Hobbs, Douglas Brown, B.A., Met., Church Hill, Md.
(*University of the South.*)
Huebner, Richard Victor, B.S., Bus., Allentown.
(*Pennsylvania Military College.*)
Leighton, Tomas Rafael, C.E., E.M., Santiago, Chile.
(*University of Chile.*)
Lloyd, Francis James, B.A., C.E., Pocomoke City, Md.
(*St. John's College.*)
Marsh, Harry Harrison, Jr., A.B., E.E., Wheeling, W. Va.
(*Marietta College.*)
Tait, Watson Fergus, Jr., A.B., E.E., Parkersburg, W. Va.
(*Marietta College.*)

Danieri, Francisco, A.N., Spl. Met., Buenos Ayres, Argentine Republic, S. A.
(*Argentine Naval Academy.*)
Pelot, Joseph Halley, U.S.A., Spl. Met., Washington, D. C.
(*United States Military Academy.*)
Darrow, Robert Turner, U.S.N., Spl. Met., Washington, D. C.
(*United States Naval Academy.*)
Granat, William, U.S.N., Spl. Met., San Francisco, Cal.
(*United States Naval Academy.*)
Morell, Norberto (Salinas), S.N., Spl. Met., Cartagena, Spain.
(*Spanish Army Artillery School.*)
Uihlein, Ralph Alfred, Ph.B., Spl. Met., Milwaukee, Wis.
(*Yale University.*)

SENIOR CLASS

Class of 1921

	Course	Residence
Alden, John Herbert,	El.Met.,	Washington, D. C.
Arner, William Joseph,	El.Met.,	Allentown.
Bailey, Harry Chantler,	C.E.,	Crafton.
Barthold, Allen Jennings,	B.A.,	Bethlehem.
Baver, David Ezra,	E.E.,	Shoemakersville.
Berger, Edgar Milton,,	M.E.,	Allentown.
Berner, Carl Richard	C.E.,	Pottsville.
Bertolet, John Lorah,	Ch.E.,	Reading.
Bevan, Lathrop,	C.E.,	East Orange, N. J.
Billinger, Robert Dominick,	Ch.E.,	Shenandoah.
Bingham, William Redmond,	Met.,	Harrisburg.
Blake, Robert Dayton,	B.A.,	Bethlehem.
Boland, William Henry,	M.E.,	Bethlehem.
Bowden, Edmund Warren,	C.E.,	Camden, N. J.
Boynton, Henry Gaines,	Bus.,	New York, N. Y.
Brucher, Adam, Jr.,	B.A.,	Northampton.
Brugmann, William Hugh,	Met.,	Rutland, Vt.
Burgess, Eugene Willard,	Bus.,	Chicago, Ill.
Butz, Louis Neuweiler,	El.Met.,	Allentown.
Chen, Chi-fah,	E.M.,	Amoy, China.
Childs, George Lawton,	Bus.,	New York, N. Y.
Childs, Raymond Austin,	Bus.,	New York, N. Y.
Chou, Smie S. K.,	M.E.,	Patung, Hupeh, China.
Christman, Frederick Mertz,	Ch.E.,	Reading.
Christman, LeRoy Fisher,	C.E.,	Womelsdorf.
Clark, Gerald Hunt,	B.A.,	Andover, N. J.
Claxton, Edmund,	Ch.E.,	Narberth.
Comey, Paul Van Amringe,	Ch.E.,	Wenonah, N. J.
Coppersmith, Edward Adolph,	M.E.,	Egypt.
Davenport, Harold Robertson,	El.Met.,	West Pittston.
Dembo, Louis Julius,	C.E.,	Baltimore, Md.
Dixon, Lyman LeRoy,	E.M.,	Flushing, N. Y.
Dougherty, James Gwynne,	El.Met.,	Beaver.
Dyer, Harry Buttorff,	C.E.,	Nashville, Tenn.
Esterson, Milton Max,	M.E.,	Baltimore, Md.
Ettelman, Benjamin,	C.E.,	Philadelphia.
Farrington, James Royce,	C.E.,	Annandale, N. J.

Feringa, Peter Anthony,	C.E.,	Grand Haven, Mich.
Fisher, Lloyd Wellington,	B.A.,	Reading.
Flanagan, Frank Patrick,	E.M.,	Roanoke, Va.
Fleischer, Abraham,	C.E.,	Baltimore, Md.
Flom, Samuel Louis,	C.E.,	Northampton.
Forstall, Alfred Edmond, Jr.,	Bus.,	Montclair, N. J.
Frank, Paul Melville,	E.M.,	Allentown.
Frankenfield, Warren Ezra,	M.E.,	Ambler.
Gaiser, George Lincoln,	C.E.,	Newark, N. J.
Garrett, William Starling,	M.E.,	Roanoke, Va.
Goldman, Hyman,	Ch.E.,	Easton.
Gonzales, Eduardo,	M.E.,	Torreon, Mexico.
Good, Robert Charles,	Met.,	Camp Hill.
Goodwin, James Heathcott,	Bus.,	East Liverpool, O.
Gott, Engene Cissell, Jr.,	El.Met.,	Washington, D. C.
Gulick, Henry Burr,	Ch.E.,	Brooklyn, N. Y.
Hall, Frank Allen,	B.A.,	Middletown, Conn.
Hall, William McLaurine, Jr.,	ChE.,	Parkersburg, W. Va.
Hartzell, Ralph,	Bus.,	York.
Heiligman, Harold Abraham,	Ch.E.,	Lehighton.
Henneberger, Thomas Clinton,	E.E.,	Chambersburg.
Henrich, Vincent Christian,	Ch.E.,	Lebanon.
Hicks, Robert Clayton, Jr.,	E.E.,	Philadelphia.
Hollenback, Elliott Hudson,	El.Met.,	Wyomissing.
Hollinshead, Earl Darnell,	E.M.,	Mt. Kisco, N. Y.
Hood, John William,	El.Met.,	Knoxville, Tenn.
Huebner, James Kistler Mosser,	E.M.,	Allentown.
Ilyus, Edmund Burwell,	E.E.,	Lancaster.
Jenness, Edwin Hutchins,	M.E.,	Henry, Ill.
Judson, Walter Joseph,	C.E.,	Washington, D. C.
King, Walter Cornelius,	Ch.E.,	Bethlehem.
Kleckner, Ellis Henry,	M.E.,	Bethlehem.
Kline, John Milton,	Met.,	Allentown.
Kline, Luther Henry,	B.A.,	Northampton.
Knerr, George Russell,	Ch.E.,	Allentown.
Larson, Harry Gustave,	C.E.,	Limestone, N. Y.
Lawrie, William Newbold,	Bus.,	Oxford.
Lewers, William Wright,	Ch.E.,	Wilkes-Barre.
Locke, Harold Glenwood,	Ch.E.,	Camden, N. J.
Loeser, Edward Martin,	Ch.E.,	Elizabeth, N. J.
Maddox, Henry Randolph,	M.E.,	Baltimore, Md.
Maginnes, Albert Bristol,	B.A.,	Sharon, Mass.

March, Walter Stokley, Jr.,	E.M.,	Cynwyd.
Maurer, Charles Pehle,	E.M.,	Wilkes-Barre.
Miller, Albert Jacob,	M.E.,	Easton.
Miller, Frank William,	C.E.,	Reading.
Morgan, James Willard,	E.M.,	Altoona.
Morgan, Warren Thomas,	M.E.,	Freeland.
Mullady, Thomas Francis,	E.M.,	Brooklyn, N. Y.
Myers, Walter Frey, Jr.,	E.M.,	York.
Nass, George, III.,	M.E.,	Philadelphia.
Nesterowicz, John James,	Ch.E.,	Buffalo, N. Y.
Norkiewicz, John Anthony,	C.E.,	Shenandoah.
Oehm, Frederick Arthur,	M.E.,	Baltimore, Md.
Ostrolenk, Samuel,	E.E.,	Canby, Minn.
Overton, Sereno Burnell,	M.E.,	Southampton, N. Y.
Parker, Willis, Jones,	B.A.,	West Pittston.
Perry, Robert Swain, Jr.,	Ch.E.,	New York, N. Y.
Pfeiffer, David Clifford,	M.E.,	Washington, D. C.
Power, Paul Carroll,	Met.,	Crafton.
Powles, John Grant,	Met.,	Los Angeles, Cal.
Pumphrey, John Walter,	C.E.,	Brooklyn, Md.
Pursel, Harold Reinhardt,	M.E.,	Danville.
Raiguel, Jackson Bornman,	Ch.E.,	Jenkintown.
Rathbone, Monroe Jackson, Jr.,	Ch.E.,	Parkersburg, W. Va.
Rheinfrank, Frederick Wagner,	Bus.,	Port Chester, N. Y.
Richards, Samuel Simes, Jr.,	Ch.E.,	Rosemont.
Riebe, Herman William,	C.E.,	Lansford.
Ritchie, Paul,	M.E.,	Millville, N. J.
Robinson, Robert Parks,	C.E.,	Chester.
Rogers, Bryant King,	E.M.,	Montclair, N. J.
Roche, George Joseph,	E.E.,	Baltimore, Md.
Roy, Ernest Hood,	M.E.,	Newton, N. J.
Roy, Ernest Hood,	Ch.E.,	Mt. Airy, Md.
Rudy, Walter Dana,	Ch.E.,	Mt. Airy, Md.
Sakievich, Anthony Joseph,	C.E.,	Baltimore, Md.
Savaria, Gaspard Maurice,	E.E.,	Woonsocket, R. I.
Sayre, William Heysham, Jr.,	M.E.,	Glen Ridge, N. J.
Schrader, Michael Cornelius,	B.A.,	Bethlehem.
Schubert, Charles Samuel,	E.M.,	Roanoke, Va.
Schulz, Donald deVantier,	Met.,	Bethlehem.
Shipherd, John Jay,	Ch.E.,	Evansville, Ind.

Skillman, John Malcolm,	E.E.,	Oldwick, N. J.
Slabasesky, Henry Theodore,	E.E.,	Ashley.
Steacy, Henry Hershey,	M.E.,	York.
Stelle, Harold Alexander,	Ch.E.,	Scranton.
Summers, Milo Whitney,	C.E.,	Washington, D. C.
Sunderland, William Alexander,	E.M.,	Danbury, Conn.
Thomas, Ross Raymond,	M.E.,	Hammonton, N. J.
Thompson, George Stephen,	E.M.,	Shaft.
Tinker, Edward Lay,	E.E.,	West Haven, Conn.
Vogeley, Theodore Kenneth,	E.M.,	Butler.
Wasser, Norman Henry,	Ch.E.,	Bethlehem.
Weiss, Peter Francis,	B.A.,	Bethlehem.
Wentz, Ralph Roth,	El.Met.,	Allentown.
Whitmore, William Kendal,	E.M.,	Shamokin.
Widmyer, John Henry,	Chem.,	Lancaster.
Wildman, George Andrew,	E.E.,	Bridgeport, Conn.
Willard, Bradford,	B.A.,	Plainfield, N. J.
Wilson, Alvin Turner,	Ch.E.,	Bethlehem.
Woodring, Ralph Walton,	Ch.E.,	Bethlehem.
Wright, Charles Henry,	C.E.,	St. Clair.
Wright, Henry Ovington,	M.E.,	Westfield, N. J.
Yeide, Harry Elwood,	E.E.,	Weatherly.
Yu, Ching-Sung,	C.E.,	Kulangsu, Amoy, China.

JUNIOR CLASS

Class of 1922

	Course	Residence
Allen, Roy Dawson,	M.E.,	Belvidere, N. J.
Alrich, John Duffield,	E.E.,	Bethlehem.
Bachman, Wilbur George Tripple,	Bus.,	Allentown.
Bailley, Fred Elliott,	N.E.,	Cazenovia, N. Y.
Barthold, Lee Girard,	Bus.,	Bethlehem.
Beeckel, Hermann Charles,	E.M.,	Philadelphia.
Blom, Gustav Maurice,	C.E.,	Bethlehem.
Bobbin, Raymond Joseph,	Bus.,	Shenandoah.
Boltz, Joseph Light,	N.E.,	Lebanon.
Bowler, William Lloyd,	M.E.,	Glenside.
Bowman, Henry Tregellas,	M.E.,	Schuylkill Haven.
Bowman, Nelson, Blair,	E.M.,	Brownsville.

Bowman, Paul Emil,	Ch.E.,	Schuylkill Haven.
Brewer, Warren,	N.E.,	Newton Center, Mass.
Brumbaugh, Granville Martin,	E.E.,	Washington, D. C.
Brunstein, Maurice,	Ch.E.,	Atlantic City, N. J.
Bush, Donald Moyer,	Ch.E.,	Bethlehem.
Carey, James Stark,	Ch.E.,	Harrisburg.
Carpenter, Clinton Grier,	Ch.E.,	Brooklyn, N. Y.
Carroll, Henry,	M.E.,	Bethlehem.
Chen, Chung-Fa,	E.M.,	Changsha, China.
Chisholm, Henry Lewis, Jr.,	M.E.,	Buffalo, N. Y.
Clark, Richard James,	Ch.E.,	Bethlehem.
Cohen, Aaron Jacob,	C.E.,	Trenton, N. J.
Cohen, Samuel Meyer,	C.E.,	Bridgeport, Conn.
Coleman, Lee Heicher,	M.E.,	Steelton.
Connell, Charles Augustus,	M.E.,	Plattsburg, N. Y.
Corcoran, Lewis La Mont,	C.E.,	Bethlehem.
Cottrell, Samuel, Jr.,	Ch.E.,	Takoma Park, D. C.
Craig, Colgate,	Ch.E.,	Montclair, N. J.
Crawford, James Coalter, Jr.,	E.M.,	Mount Vernon, N. Y.
Culler, Roy Lester,	M.E.,	Mechanicsburg.
Daniels, Elliott Foster,	E.E.,	Jersey City, N. J.
Davis, Guild Darwin,	M.E.,	East Orange, N. J.
Day, Harrie Lyon,	Met.,	Ogdensburg, N. Y.
Deats, Charles Taylor,	E.E.,	Flemington, N. J.
DeTurk, Elmer Francis,	E.E.,	Reading.
Dimmig, Daniel Benjamin,	E.M.,	East Greenville.
Doan, William Douglas,	E.M.,	Lansdale.
Donovan, William Michael,	Bus.,	Philadelphia.
Downes, Kenneth McIntire,	Met.,	Harrisburg.
Downing, Edmond Joseph,	C.E.,	Scranton.
Drew, Leslie Lungren,	Bus.,	Asbury Park, N. J.
Dunkle, Charles Josiah,	Bus.,	Harrisburg.
Eastman, Robert William,	Met.,	Mount Vernon, O.
Eisenberg, Aaron Archibald,	Ch.E.,	Baltimore, Md.
Enslin, Everett Morgan,	N.E.,	Wilkes-Barre.
Ewing, George Newlin,	Met.,	Philadelphia.
Foote, Marshall Hanford,	Bus.,	South Norwalk, Conn.
Frain, Jacob Frank,	C.E.,	Williamsport.
Frankel, Harry,	B.A.,	Wilmington, Del.
Fresoli, Michael,	B.A.,	Bethlehem.
Fretz, John Clement,	E.E.,	Trenton, N. J.

Gangewere, Ernest Paul,	M.E.,	Chattanooga, Tenn.
Gerber, William Eugene,	Ch.E.,	York.
Gerlach, Jacob Aaron,	M.E.,	Easton.
Gillespie, Elwood David,	Ch.E.,	Catasauqua.
Glasmire, Frederick Wanner,	Ch.E.,	Bethlehem.
Glen, Maxwell,	Bus.,	Newbury, Mass.
Goldcamp, Cyril Finton,	Ch.E.,	Ironton, O.
Gooding, Charles Pennypacker,	B.A.,	Wilmington, Del.
Green, David,	N.E.,	Atlantic City, N. J.
Greenall, Charles Huntington,	M.E.,	Allentown.
Greene, Omar Vivien,	Met.,	Yonkers, N. Y.
Greenleaf, Eric Rodney,	Ch.E.,	Glen Ridge, N. J.
Gross, Abraham Albert,	Ch.E.,	Harrisburg.
Gulick, Wilson McKee,	E.M.,	Orange, N. J.
Handwerk, Erwin Casper,	E.M.,	Slatedale.
Hartshorne, Alfred Cope,	N.E.,	Phoenixville.
Herman, Arthur Louis,	Met.,	Bethlehem.
Herrington, Arthur Smith,	Bus.,	Latrobe.
Hewitt, Alfred George,	Ch.E.,	Washington, D. C.
Hindry, Walter Fitz James,	Ch.E.,	St. Augustine, Fla.
Hoch, Albert Jackson,	Met.,	Reading.
Hocker, John Stanley,	Met.,	Middletown.
Horine, John Winebrenner, Jr.,	E.E.,	Columbia, S. C.
Huang, Shou-Chuan,	E.M.,	Kaiping, Chihli, China.
Huber, Francis, Christian,	Ch.E.,	New York, N. Y.
Huffman, Francis Miller,	Met.,	Bethlehem.
Hughes, Rupert De Armond,	Ch.E.,	Montclair, N. J.
Ide, Clinton,	E.E.,	Harvey's Lake.
Irvin, Robert Lintner,	Met.,	Meadville.
Israel, Fielder,	Ch.E.,	Laurel, Md.
Jacobs, Frank Aaron,	Ch.E.,	Bethlehem.
Jacobs, Mahlon Kemmerer,	E.M.,	Philadelphia.
Jagels, Charles John Henry,	B.A.,	New York, N. Y.
Jefferson, Moncrief Ostrander,	N.E.,	Riverhead, N. Y.
Job, James Robert,	C.E.,	Nanticoke.
Kahn, Noah Abraham,	Ch.E.,	Bethlehem.
Keeley, Martin Jerome,	Bus.,	Jersey City, N. J.
Keenan, Raymond Anthony,	Met.,	New Kensington.
Kehler, Lloyd Benjamin,	M.E.,	Shamokin.
Kilbourn, William Robert,	M.E.,	Williamsport.
Kistler, George Anson,	C.E.,	Allentown.

Kivert, Joseph Albert,	Ch.E.,	Northampton.
Kleine, Herbert Julius,	M.E.,	Philadelphia.
Knies, Earl Vernon,	M.E.,	Bethlehem.
Knoderer, Claude Luther,	E.E.,	Steelton.
Korbel, Alexander,	M.E.,	Bethlehem.
Kozlakiewicz, Walter,	C.E.,	Wilkes-Barre.
Lamb, Earl Washington,	E.M.,	Natalie.
Larkin, Paul Revere,	C.E.,	Wollaston, Mass.
Larkin, Sylvester Makens,	C.E.,	Norristown.
Lerch, Robert Lee,	Ch.E.,	Takoma Park, D. C.
Linderman, Robert Packer,	Bus.,	Bethlehem.
Little, Arthur Rhea,	Met.,	Petersburg.
Lorch, George Herman,	E.E.,	Washington, D. C.
Lutz, Warren Hornberger,	E.E.,	Denver.
McGovern, Edward William,	Ch.E.,	Hammonton, N. J.
Major, Harold Wagner,	Ch.E.,	Lehman.
Maraspin, Davis Goodwin,	Bus.,	Malden, Mass.
Marshall, James Floyd,	M.E.,	Wilkes-Barre.
Marshall, John Noble,	C.E.,	Pittsburgh.
Mattson, William Raymond,	C.E.,	Rockledge.
de Menezes, Godofredo Moraes,	C.E.,	Brazil.
Michell, Albert McIlvaine,	E.M.,	Marion, Ky.
Miller, Paul Edward,	N.E.,	Bellwood.
Miller, Roy Francis,	E.M.,	Altoona.
Moorehouse, John Walter,	E.E.,	Monaca.
Morgan, Harold William,	C.E.,	Altoona.
Morris, Richard Henry, 3rd,	Ch.E.,	Philadelphia.
Mumma, Paul Fisher,	Met.,	Waynesboro.
Newlin, James Mennert,	E.M.,	Sparrows Point, Md.
O'Keefe, Gerald Carroll,	Bus.,	East Haven, Conn.
Pfeiffer, John,	Ch.E.,	Washington, D. C.
Platt, Harold Wentzell,	C.E.,	Bridgeton, N. J.
Potts, Ralph Harrison,	Ch.E.,	Reading.
Prigohzy, Adolph,	E.M.,	Brooklyn, N. Y.
Raff, Richard Davis,	Ch.E.,	Canton, O.
Reichard, Paul Clader,	M.E.,	Allentown.
Reynolds, Edwin Louis,	C.E.,	Bethesda, Md.
Rhoad, Robert Rodney,	N.E.,	Philadelphia.
Ricketts, Leslie Cutler,	M.E.,	Barre, Mass.
Salmon, Clarence Prior,	Met.,	La Salle, N. Y.
Saltzman, Auguste Louis,	M.E.,	East Orange, N. J.

Sanborn, Norman Prime,	C.E.,	Cleveland, O.
Satterthwait, Charles Shoemaker,	C.E.,	Burmont.
Schaefer, Bernard Edward,	E.M.,	Allentown.
Schier, Wallace,	Bus.,	Kew Gardens, L. I.,
Schlesman, Carlton Hecker,	Ch.E.,	Allentown. N. Y.
Schneider, Carl Louis,	M.E.,	Elizabeth, N. J.
Schwartz, Earl Dum,	C.E.,	Harrisburg.
Shearer, Walter Louis,	Ch.E.,	Washington, D. C.
Shipley, Samuel Hunt,	Ch.E.,	York.
Silsby, Charles Forbes,	Ch.E.,	Washington, D. C.
Smith, Hubert Bell,	C.E.,	Philadelphia.
Spatz, Warren Cyrus,	E.E.,	Reading.
Steiner, Carl Herman,	E.E.,	Reading.
Stimson, Earl, Jr.,	M.E.,	Baltimore, Md.
Strauch, Charles Carter,	M.E.,	Pottsville.
Stutz, George Frederick Adelbert, Jr.,	Ch.E.,	Washington, D. C.
Summers, Milo Whitney,	E.M.,	Washington, D. C.
Swinton, George Robert,	C.E.,	Atlantic City, N. J.
Switz, Theodore MacLean,	Ch.E.,	East Orange, N. J.
Tavenner, William Henry,	E.M.,	Washington, D. C.
Terry, Peyton Leftwich,	M.E.,	Roanoke, Va.
Thaeler, Abraham Schropp,	N.E.,	Nazareth.
Tombler, Joseph,	Ch.E.,	Baltimore, Md.
Van Nort, Lawrence Northup,	M.E.,	Scranton.
Vogt, Harold James,	Ch.E.,	Brooklyn, N. Y.
Wallace, Harold Dolson,	C.E.,	East Orange, N. J.
Walters, George Wilmer,	E.M.,	Cazenovia, N. Y.
Waltz, William Hurr,	C.E.,	Williamsport.
Warren, Austin Bartlett,	N.E.,	Westfield, Mass.
Weber, Herman Ludwig,	B.A.,	Allentown.
Whims, Edmund Joseph,	C.E.,	St. Clair.
Whitney, Leslie Clifton,	Met.,	Marlboro, Mass.
Whytock, Paul Knauss,	Bus.,	Bethlehem.
Williamson, Stuart Worley,	E.M.,	Womelsdorf.
Wilson, John Edgar Miller,	E.M.,	Bethlehem.
Wilson, Ralph Lawrence,	Met.,	Canton, O.
Wingate, Abram Reber, Jr.,	C.E.,	Washington, D. C.
Woelfel, Harold Martin,	N.E.,	Freeland.
Wolfe, Charles Russell,	Ch.E.,	Asbury Park, N. J.

Wood, Robert Thomas,	Met.,	Palmerton.
Yap, Alfred Tsun Leong,	Bus.,	Honolulu, Hawaii.

SOPHOMORE CLASS

Class of 1923

	Course	Residence
Abel, Stanford Edward,	C.E.,	Washington, D. C.
Acker, Swope,	E.E.,	Baltimore, Md.
Adams, Robert Wilson,	E.M.,	Crafton.
Ancona, Frederick Bechtel,	E.E.,	Reading.
Appel, Carl Wilson,	E.E.,	Allentown.
Asbury, Thomas Henry,	Bus.,	Philadelphia.
Bahnsen, Conrad Mortimer,	B.A.,	Easton.
Balderson, Robert Power,	Bus.,	Pittsburgh.
Barber, Frederick Edwin,	E.E.,	Allentown.
Barrall, John Kenneth,	B.A.,	Allentown.
Barrell, Robert Webb, Jr.,	E.E.,	St. Louis, Mo.
Beale, Edward Belknap,	Ch.E.,	Washington, D. C.
Beck, Rodney Maurer,	Ch.E.,	Germantown.
Beitzel, Horace Clifton, Jr.,	M.E.,	Philadelphia.
Berry, Henry Parmentier,	E.E.,	Washington, D. C.
Bessemer, Steven Joseph,	Bus.,	Bethlehem.
Best, Ralph Walter,	E.E.,	Allentown.
Bieg, Henry Conrad,	E.M.,	Philadelphia.
Bishop, Charles Fletcher,	E.E.,	Williamsport.
Blankenbuehler, John Henry,	E.E.,	Elizabeth.
Bloch, Elmer Morton,	B.A.,	Newport, R. I.
Bodey, Carl Franklin,	E.E.,	Reading.
Borden, George Centennial, Jr.,	Ch.E.,	Asbury Park, N. J.
Boyd, James Andrew,	Bus.,	Montvale, N. J.
Boyden, Wilson Gordon,	E.E.,	Greenwich, Conn.
Boyer, Willard Albert Solomon,	B.A.,	Lehighton.
Bray, Lennox Jerome,	M.E.,	Westerly, R. I.
Brightbill, David Frantz,	E.E.,	Lebanon.
Brotzman, Reginald Philip,	E.E.,	Bethlehem.
Buckley, John Brooke,	N.E.,	Port Edwards, Wis.
Buller, William Earl,	Bus.,	Harrisburg.
Burgess, Charles Owen,	Met.,	Niagara Falls, N. Y.
Bush, Charles Roland, Jr.,	C.E.,	Washington, D. C.
Callahan, George White, Jr.,	C.E.,	Newport, R. I.

Camm, John Palmer,	E.M.,	Atlantic City, N.J.
Carey, James White, Jr.,	M.E.,	Wenonah, N. J.
Carlisle, William Albert,	E.E.,	Luthersburg.
Christman, Calvin Claude,	B.A.,	Lehighton.
Church, Allan Hudson,	Ch.E.,	Elizabeth, N. J.
Claxton, Robert Bethell, Jr.,	Bus.,	Beachwood, N. J.
Coleman, Douglas Fleming,	B.A.,	Jersey City, N. J.
Compher, Wilfred Clinton,	Bus.,	Poolesville, Md.
Conlin, John Francis,	Bus.,	Philadelphia.
Conroy, James Maurice,	B.A.,	Burlington, N. J.
Cornelius, George Emil Wagner,	Bus.,	McKeesport.
Cosh, William Harold,	C.E.,	Vineland, N. J.
Cox, Newton Perkins,	E.E.,	Philadelphia.
Coxe, Edward Haviland, Jr.,	E.E.,	Pittsburgh.
Craig, Thomas B.,	M.E.,	Slatington.
Creighton, Arthur Morgan,	Met.,	Bayonne, N. J.
Cusick, Arthur Cabot,	M.E.,	Roxbury, Mass.
Darsie, James Hazen,	E.M.,	West Homestead.
Davis, Edward Chester,	M.E.,	Taylor.
Davis, Norris Dunglison,	Bus.,	Conshohocken.
Davis, William Shaff, Jr.,	C.E.,	Lebanon.
Dawson, Henry Americus, Jr.,	Bus.,	Rockville, Md.
Decker, Everett Judd,	E.M.,	Mountain Lakes, N. J.
DeMoyer, Frank Hart,	C.E.,	Camden, N. J.
Denburger, Fred Herman,	C.E.,	Bethlehem.
DePuy, Stuart Walton,	Ch.E.,	Hammonton, N. J.
Derrick, Charles Luther,	E.E.,	Washington, D. C.
Desh, George Jacob,	B.A.,	Bethlehem.
Di Giulian, Attilio Peter,	C.E.,	Washington, D. C.
Dithridge, Edward Hay,	Ch.E.,	Morrisville.
Douglass, Leo Frederick,	Bus.,	Wakefield, Mass.
Douglas, Randolph Angus,	M.E.,	Plainfield, N. J.
DuBois, Howard Higbee,	C.E.,	Philadelphia.
Dynan, Harold Baker,	Met.,	Bethlehem.
Ekstedt, Oscar Carl,	B.A.,	Toledo, O.
Ellis, George Conkling,	Bus.,	Basking Ridge, N. J.
Erb, John Edgar,	Met.,	Middletown.
Ertner, Harold Sigmond,	C.E.,	Camden, N. J.
Eshbach, Truman Walter,	B.A.,	Bethlehem.
Fagan, Marvin Troy,	E.E.,	Weatherly.
Fancher, Charles Melvin,	N.E.,	Elizabeth, N. J.

Farace, Samuel,	E.E.,	Baltimore, Md.
Farkas, Harold,	Ch.E.,	Newark, N. J.
Fay, Frederick Hamilton,	Ch.E.,	Cranford, N. J.
Fehr, Howard Franklin,	B.A.,	Bethlehem.
Felmley, Charles Lauren,	E.E.,	Oldwick, N. J.
Ferguson, Frank Elliott, Jr.,	E.E.,	Plainfield, N. J.
Ferris, Edwin Alden,	M.E.,	Ridgefield Park, N. J.
Ferry, John Francis,	E.E.,	Allentown.
Fitch, Grant,	E.E.,	Washington, D. C.
Focht, Louis Doster,	E.M.,	Trenton, N. J.
Foot, Cyril Hughes,	M.E.,	Westfield, N. J.
Forney, Charles David,	E.E.,	Hanover.
Forstall, Charles Fletcher,	C.E.,	Rosemont.
Frazier, Donald Plumb,	Bus.,	Aurora, Ill.
Freeman, Calos Alphonso,	E.M.,	Caracas, Venezuela.
Ganey, Thomas Vincent,	Bus.,	Bethlehem.
Garber, Meyer Isadore,	Ch.E.,	Norristown.
Gardy, Julian Washington,	Bus.,	Doylestown.
Garman, Edwin Lester Meckley,	Bus.,	Penbrook.
Gentzlinger, Henry Werner,	C.E.,	New York, N. Y.
Getz, David,	B.A.,	Allentown.
Gihon, Harry David,	M.E.,	Trenton, N. J.
Goldberg, Horace Harrison,	B.A.,	Jenkintown.
Graff, Richard Morris,	E.M.,	Worthington.
Graham, George Tinsley,	Bus.,	Bethlehem.
Green, Kenneth William,	E.E.,	Weissport.
Groff, Joseph Coblentz,	M.E.,	New York, N. Y.
Grundy, Park Alan,	Bus.,	New York, N. Y.
Guthrie, Nelson Rawlins, Jr.,	C.E.,	Baltimore, Md.
Hacker, Robert Trost,	E.M.,	Toledo, O.
Hafler, LeRoy Amandus,	C.E.,	Bingen.
Hagenbuch, Edward Allen, Jr.,	E.E.,	Allentown.
Hager, William Franklin,	Bus.,	Bethlehem.
Haldeman, Samuel Tyson,	N.E.,	Williamsport.
Hales, Ralph Alonzo,	Ch.E.,	Washington, D. C.
Hallihan, Edward Britt,	Bus.,	New York, N. Y.
Hardcastle, Edward,	E.E.,	Easton, Md.
Harkins, Linus Kenneth,	B.A.,	Homestead.
Harris, Thomas Wilson,	C.E.,	Athens.
Hartung, Philip Halstead,	M.E.,	Yonkers, N. Y.

Hauck, Adam Edward,	E.M.,	Buffalo, N. Y.
Heikes, George Conrad,	Met.,	Salt Lake City, Utah.
Hendrickson, Lynn Francis,	Ch.E.,	Woodbury, N. J.
Hicks, Albert Willet, Jr.,	E.M.,	Allentown.
Hiestand, John Engle,	Met.,	Bainbridge.
Hogg, Wallace Bruce,	Bus.,	Pittsburgh.
Hogue, Francis Herbert Kerr,	E.M.,	Philadelphia.
Hoke, William Mason,	E.E.,	Lebanon.
Hornbostel, Lloyd,	M.E.,	New York, N. Y.
Huggins, Georg Allen, 3d,	M.E.,	Brooklyn, N. Y.
Huston, James Stewart,	Met.,	Coatesville.
Israel, Charles Henry, Jr.,	Ch.E.,	Philadelphia.
Jacobson, Louis John,	C.E.,	Washington, D. C.
Johnson, Alfred William,	E.E.,	West Hartford, Conn.
Johnston, Byron Albert Chapman,	E.M.,	Tompkinsville, N. Y.
Kaman, Samuel,	B.A.,	New York, N. Y.
Kennedy, Jamieson Douglas,	B.A.,	North Adams, Mass.
Kiechel, Leonard David,	Bus.,	Northampton.
Klaas, Walter Ernest,	Bus.,	Montclair, N. J.
Klippel, Earl Frederick,	E.E.,	New York, N. Y.
Knodel, Charles Gotthilf,	M.E.,	Allentown.
Knouse, Walter Earl,	E.E.,	Washington, D. C.
Koch, George Schneider,	E.E.,	Washington, D. C.
Kocher, Walter Merritt,	C.E.,	Allentown.
Kofke, Charles Lewis,	Met.,	Philadelphia.
Kramer, Allan Reuel,	E.E.,	Coplay.
Kramer, Harold Kusel,	M.E.,	Brooklyn, N. Y. ,
Kravitz, Raphael,	C.E.,	Atlantic City, N. J.
Kreisel, John Werner,	B.A.,	Pen Argyl.
Kressler, Charles Horner,	E.E.,	Finesville, N. J.
Kurtz, Irwin Faust,	C.E.,	Pottstown.
Kutzleb, Richard, Jr.,	M.E.,	Baltimore, Md.
Lambert, Tilghman Albert,	B.A.,	Allentown.
Laufer, Harry Edgar,	Bus.,	Bethlehem.
Laughton, William Miller,	Met.,	Washington, D. C.
Lawrence, Ernest,	B.A.,	Bristol.
Lazarus, Franklin Thomas Wright,	Bus.,	Bethlehem.
Lebovitz, Samuel Llewellyn,	E.M.,	Baltimore, Md.

Lee, Ralph William, Jr.,	C.E.,	Washington, D. C.
Lees, John Luther,	C.E.,	Bethlehem.
Leister, Frank Henry, Jr.,	C.E.,	North Wales.
Lewis, Frederick William,	B.A.,	Pottsville.
Light, Joel Longnecker,	E.M.,	Allentown.
Light, Simon Peter, Jr.,	E.E.,	Lebanon.
Liveright, Henry, Jr.,	Ch.E.,	Clearfield.
Lodge, Friend Horace,	C.E.,	Philadelphia.
Lohmann, Louis John,	E.E.,	Scranton.
Loose, Henry Troxell,	Bus.,	Allentown.
Lyons, Grant Maxwell,	B.A.,	Warren.
McCarthy, Raymond Timothy,	Bus.,	Easton.
McConnell, George D.,	Bus.,	Butler.
McFadden, Michael Charles Joseph,	Met.,	Bethlehem.
McNulty, Carrell Stewart,	C.E.,	Washington, D. C.
McPherson, John Douglas, 3d.,	E.E.,	Fair Oaks, Cal.
Magruder, Elbert Tyler,	M.E.,	Winchester, Va.
Mecaslin, Harry Benton, Jr.,	E.E.,	Baltimore, Md.
Meyer, Theodore Henry,	M.E.,	Newark, N. J.
Millar, Glenn Leroy,	M.E.,	Ensley, Ala.
Miller, Charles Heck,	Ch.E.,	Wilkes-Barre.
Minnich, Charles Raymond,	C.E.,	Robesonia.
Minnich, Joseph Pilkay,	E.E.,	Harrisburg.
Miszkiel, Victor S.,	E.E.,	Ashley.
Mitman, Frederick Snyder,	E.M.,	Bethlehem.
Mitman, Harry Ammon,	Ch.E.,	Northampton.
Molloy, James Xavier,	N.E.,	Bridgeport, Conn.
Moyer, Joseph Fretz,	C.E.,	Quakertown.
Muirhead, Andrew Wilson,	M.E.,	Bridgeport, Conn.
Muschlitz, Wilbert David,	B.A.,	Bethlehem.
Mutch, Thomas Sangster,	E.M.,	Bryn Mawr.
Muzdakis, John Robert,	M.E.,	Baltimore, Md.
Nadig, Stanton Elwell,	N.E.,	Allentown.
Nevins, Samuel Craig,	Ch.E.,	Tamaqua.
O'Donnell, Thomas Alfonsus,	B.A.,	Eckley.
O'Keefe, Francis Callistus,	Bus.,	Rockville, Conn.
Olcott, John Hedrick,	C.E.,	Glencarlyn, Va.
Old, Marcus Calvin,	B.A.,	Allentown.
Opdycke, John Hinkle,	Bus.,	Philadelphia.

Orlando, Samuel Palella,	E.E.,	Bridgeton, N. J.
Palmer, Henry Parsons,	C.E.,	Langhorne.
Passmore, Henry Etter, Jr.,	M.E.,	Columbus, O.
Patterson, Robert Livingston, Jr.,	Ch.E.,	Elizabeth, N. J.
Petersen, Theodore Otto,	Ch.E.,	Philadelphia.
Pfahler, Robert Gair,	E.M.,	Wilkes-Barre.
Philippides, John Argyrios,	B.A.,	Athens, Greece.
Picht, George Christopher, Jr.,	E.E.,	Bethlehem.
Pierce, Jonathan Dorr,	Bus.,	Montclair, N. J.
Piersol, John,	M.E.,	Philadelphia.
Pill, Frank, Jr.,	B.A.,	Califon, N. J.
Platt, Robert,	Ch.E.,	Westfield, N. J.
Plumb, Rollo Green,	B.A.,	Bethlehem.
Quick, Donald Mott,	M.E.,	Yonkers, N. Y.
Quier, Kenneth Elwell,	M.E.,	Bethlehem.
Quigley, Raymond Joseph,	Ch.E.,	Jeddo.
Randall, Harradon R.,	C.E.,	Shamokin.
Randall, Nathaniel Gilroy,	Bus.,	Hanover.
Read, John Mason,	C.E.,	Washington, D. C.
Redington, Joseph Patrick,	Bus.,	Wilkes-Barre.
Regad, Eugene Desire,	E.E.,	Irvington, N. J.
Reid, Byron G.,	B.A.,	Hartford, Conn.
Reif, Fulmer Jacob, Jr.,	Ch.E.,	Harrisburg.
Reiter, Irvin Sterner,	Met.,	Bethlehem.
Reynolds, Joseph Lee,	M.E.,	Dorranceton.
Rhoades, Ronald Sags,	E.M.,	Nutley, N. J.
Rhode, Harold Cyrus,	E.M.,	Kutztown.
Richards, Elmer Lincoln, Jr.,	C.E.,	Somerville, N. J.
Rieman, Edwin Frederick,	E.E.,	Tamaqua.
Riley, John Stephen,	E.E.,	Willimantic, Conn.
Roberts, Evan Emlyn,	M.E.,	Dunmore.
Robinson, John Bunyan,	E.M.,	Chester.
Robnett, John David, Jr.,	E.E.,	Washington, D. C.
Rodgers, Samuel Procter,	M.E.,	Baltimore, Md.
Rodriguez, Abraham,	C.E.,	Chapparal, Tulima, Colombia, S. A.
Roller, Oscar Frederic, Jr.,	Ch.E.,	Philadelphia.
Roney, David Martin,	Bus.,	Philadelphia.
Roth, Leonard William,	Bus.,	Philadelphia.

Ruger, Raymond Philip,	C.E.,	Philadelphia.
Sansom, Edward Marsh,	Ch.E.,	Cranford, N. J.
Saunders, Oliver Hubbard, Jr.,	M.E.,	Brooklyn, N. Y.
Schaefer, Everett Gordon,	Ch.E.,	New York, N. Y.
Scheirer, Charles Worthington,	Ch.E.,	Jonestown.
Schifreen, Clement Solomon,	E.E.,	Catasauqua.
Schragger, Charles Nelson,	Ch.E.,	Trenton, N. J.
Schrauff, Henry John,	C.E.,	Jersey City, N. J.
Schwab, Thomas Wesley, Jr.,	B.A.,	Bath.
Schwarzbach, Alvin Angust Claus,	E.M.,	Newark, N. J.
Scofield, Edmond Preston,	Ch.E.,	Bayonne, N. J.
Sehring, Fred George,	B.A.,	Joliet, Ill.
Settle, Richard Torpin,	Ch.E.,	Drexel Hill.
Shaw, Hugh Curtis,	Bus.,	Tidioute.
Sheedy, Clayton McGowan,	Bus.,	Groton, Mass.
Sheetz, Olin Curtis,	Met.,	East Stroudsburg.
Shelly, Freeman Moyer,	Bus.,	Allentown.
Shoemaker, H. E. Walter,	C.E.,	Freeland.
Shoemaker, Lewis Foulke, Jr.,	C.E.,	Devon.
Siemann, Arthur Louis,	C.E.,	Brooklyn, N. Y.
Smith, Leslie Ewart,	E.M.,	East Mauch Chunk.
Smith, Thomas Cameron,	M.E.,	Allentown.
Snyder, Edwin Henry, Jr.,	E.E.,	Washington, D. C.
Spindler, Henry,	M.E.,	Jersey City, N. J.
Sprague, John Frederick,	M.E.,	Raleigh, N. C.
Stafford, Samuel Alfred,	Met.,	Coraopolis.
Stanier, John Stewart,	Bus.,	Tarentum.
Stanley, Leslie Wright,	B.A.,	Williamsport.
Steiner, William Joseph Henry,	Bus.,	New York, N. Y.
Stanton, Thomas William,	Bus.,	Newark, N. J.
Stoll, John Howard,	Met.,	Bethlehem.
Sylvan, Rolf,	Bus.,	Montclair, N. J.
Talmage, Herbert Richard,	C.E.,	Irvington, N. J.
Taylor, John Wright, Jr.,	M.E.,	Century, Fla.
Taylor, Thomas Rogers,	Ch.E.,	Palmyra, N. J.
Thomas, Hopkin Buckland,	M.E.,	Catasauqua.
Thomas, John Archibald,	E.M.,	Helen, W. Va.
Thompson, William Gardiner,	C.E.,	Richmond Hill, N. Y.
Todd, James Arnold,	Ch.E.,	Doylestown.
Trumbore, Frederick William,	M.E.,	Bethlehem.

Tullidge, George Bowler, Jr.,	M.E.,	Philadelphia.
Turner, Clarence Hutchins,	E.E.,	Schenectady, N. Y.
Underwood, Herbert Francis,	M.E.,	Brooklyn, N. Y.
Van Billiard, Lewis Howard,	E.E.,	Elizabeth, N. J.
Van Keuren, Edwin,	B.A.,	Bethlehem.
Van Ness, John Harold,	C.E.,	Paterson, N. J.
Vilotti, James Victor,	Bus.,	Philadelphia.
Voss, Charles Abbott,	Bus.,	Brooklyn, N. Y.
Wallace, Edward Allen, Jr.,	Bus.,	Grand Rapids, Mich.
Walters, Frank Clayton,	B.A.,	Bethlehem.
Walton, Joseph Edward,	C.E.,	Bethlehem.
Warriner, Farnham,	Bus.,	Philadelphia.
Way, William Henry,	M.E.,	Coatesville.
Webb, Robert Stanford,	M.E.,	Asheville, N. C.
Wells, George Herbert, Jr.,	Ch.E.,	Brooklyn, N. Y.
Wentling, Lee Grant,	M.E.,	Conshohocken.
Wentz, James,	Bus.,	New York, N. Y.
Werft, Ellis Lincoln,	E.M.,	Altoona.
Werner, David Thomas,	E.E.,	Lebanon.
Wight, Donald Miller,	M.E.,	Washington, D. C.
Wilkins, Paul Edwin,	C.E.,	Baltimore, Md.
Wilson, Edwin Franklin,	E.E.,	Gastonville.
Wilson, Frederic William, Jr.,	E.E.,	Pocomoke, Md.
Wilson, Samuel Marshall,	Bus.,	Glenside.
Wingate, Bruce Kuglow,	C.E.,	Reading.
Wire, Charles Raymond,	C.E.,	Washington, D. C.
Wolensky, Barney Louis,	Bus.,	Palmerton.
Wright, Frederic Flavel,	Bus.,	Harrisburg.
Wuethrich, Adolph Gustave,	Met.,	Perth Amboy, N. J.
Young, Harry Elmer,	Ch.E.,	Atlantic City, N. J.
Yott, George Malcolm Doge,	Bus.,	New York, N. Y.
Zantzinger, Richard Chew,	Bus.,	Washington, D. C.

FRESHMAN CLASS

Class of 1924

	Course	Residence
Abel, David Heaton,	B.A.,	Philadelphia.
Abel, George Justin,	E.E.,	Elizabeth, N. J.
Adams, Edgar Thomas, Jr.,	E.M.,	Crafton.
Alex, Joseph Leonard,	E.E.,	Shenandoah.
Alford, Charles Mahin,	E.E.,	East Orange, N. J.

Allan, Robert Houston,	Bus.,	Jermyn.
Alwine, Charles Emory,	E.E.,	New Oxford.
Anderson, Lansdell,	E.E.,	New York, N. Y.
Andrews, Walter Crane,	Bus.,	Newark, N. J.
Angulo, Antonio,	M.E.,	Barranquilla, Colombia, S. America.
Angulo, Isaac Carlos,	Ch.E.,	Barranquilla, Colombia, S. America.
Arter, Adelbert Allison,	E.M.,	Youngstown, O.
Arthurs, Biddle,	E.E.,	Pittsburgh.
Atwood, Henry Martyn,	B.A.,	Buffalo, N. Y.
Ayers, William DeWitt,	C.E.,	Branchville, N. J.
Baker, Ernest Wellington,	E.E.,	Harrisburg.
Barton, Frederic Charles, Jr.,	E.E.,	Tenafly, N. J.
Bastian, Frank Joseph,	M.E.,	Mahanoy City.
Bechtel, Edward Jacob,	M.E.,	Maywood, N. J.
Beckman, George William,	M.E.,	Hellertown.
Beech, Rozier James,	Bus.,	Washington, D. C.
Bell, George Howard,	Bus.,	Canton, O.
Bell, Harry Stanton,	Bus.,	Spartanburg, S. C.
Bell, Raymond Milton,	Bus.,	Philadelphia.
Benner, Ralph Chalfont,	M.E.,	Atglen.
Bennett, Edmund Van Gilder,	Met.,	Lansdale.
Berg, Frederick Christian,	N.E.,	Philadelphia.
Bergen, Howard Beekman,	E.E.,	Newtown.
Bishop, Morris Earl,	B.A.,	Bethlehem.
Black, John Murray,	M.E.,	Buffalo, N. Y.
Blake, Alfred Green,	M.E.,	Pittsburgh.
Blakeley, George Bogart,	Bus.,	Bethlehem.
Blessing, Raymond Joseph,	Ch.E.,	Reading.
Boggs, George Warren,	Bus.,	Philadelphia.
Bond, Frank Edward, Sr.,	B.A.,	Woburn Sands, Bucks, England.
Bond, Louis Boutell,	M.E.,	Ashbourne.
Bond, Luther Gerrer,	M.E.,	York.
Bonney, Henry Ernest,	B.A.,	Pen Argyl.
Bortz, Carl Martin,	Bus.,	Pittsburgh.
Botzer, James Patrick,	Ch.E.,	Johnsonburg.
Boyle, Joseph,	Bus.,	Paterson, N. J.
Bradley, Clifton Newton,	Bus.,	Brooklyn, N. Y.
Bridegam, Warren James,	E.E.,	Reading.

Britt, Therman Paul,	Bus.,	Abington.
Brown, Charles Daniel,	M.E.,	Altoona.
Brownmiller, Lorrin Thomas,	Chem.,	Shoemakersville.
Buck, Richard Joseph,	B.A.,	Bethlehem.
Buckbee, Henry Wisner,	C.E.,	Wisner, N. Y.
Buechley, Frank Seltzer,	Bus.,	Pottsville.
Bugbee, Jesse Albert,	C.E.,	Trenton, N. J.
Bullock, Richard Hunt Downing,	E.E.,	Philadelphia.
Bumbaugh, Frank Taylor,	Met.,	Monessen.
Burdick, William Foster,	B.A.,	Uniondale.
Burt, Paul Shafter,	Bus.,	East Stroudsburg.
Campbell, Paul Frederick,	C.E.,	Swedesboro, N. J.
Campbell, William Brunner,	Bus.,	Lebanon.
Canavan, William Paul,	B.A.,	Chester.
Carol, Jose Maria,	C.E.,	Cardenas, Cuba.
Carpenter, Harry Bartleson, Jr.,	M.E.,	Montclair, N. J.
Carter, Norman Campbell,	Ch.E.,	Phoenixville.
Chamberlin, Alan Charles,	B.A.,	Bethlehem.
Chang, Kuang-Ming,	Met.,	Shanghai, China.
Chew, Robert Zent,	Bus.,	Fredericktown, O.
Childs, Frank Lawton,	Bus.,	New York, N. Y.
Cioffi, John Mathew,	Bus.,	New York, N. Y.
Clark, John Edmund Duncan,	M.E.,	Wilmington, N. C.
Clemmer, Stanley Bachman,	Ch.E.,	Allentown.
Cluthe, Carl, 3rd,	Bus.,	Glen Ridge, N. J.
Coleman, Spencer Albert,	Met.,	Cleveland, O.
Conley, Thomas George, Jr.,	Bus.,	Pittsburgh.
Cook, Roland Fuller,	M.E.,	Glen Ridge, N. J.
Cornelius, Charles Taylor,	M.E.,	Pittsburgh.
Cousens, Harold Franklin,	Bus.,	Arlington, Mass.
Cramer, William Aurelius Wrenn,	N.E.,	Suffolk, Va.
Crawford, David William,	E.E.,	Scranton.
Crawford, Frederick Rufus,	M.E.,	McKeesport.
Crick, Linville Hamilton, Jr.,	Met.,	Pittsburgh.
Croft, Samuel, 2nd,	Bus.,	Philadelphia.
Cupp, Laylon Lavern,	M.E.,	Williamsport.
Davidson, Jacob Israel,	E.E.,	Baltimore, Md.
Davidson, Stuart Ross,	E.M.,	Elizabeth, N. J.
Dawson, Walter Williams,	Bus.,	Rockville, Md.
Degnan, James Michael, Jr.,	E.E.,	Bethlehem.

DeTurk, Wilbur Charles,	M.E.,	Cape May, N. J.
DiBiase, Claude,	Bus.,	Newark, N. J.
DiBiase, James,	Bus.,	Newark, N. J.
Dick, Arthur Ellsworth, Jr.,	Bus.,	Hazleton.
Dick, Donald Benner,	Bus.,	Hazleton.
Dickinson, Ansel Reed,	E.E.,	New Haven, Conn.
Diener, Walter Miller,	M.E.,	Hamburg.
Dietrick, Robert Charles,	B.A.,	High Bridge, N. J.
Dietz, Joseph Budding,	Ch.E.,	Lancaster.
Dixon, Henry Marshall,	Ch.E.,	Washington, D. C.
Donaldson, Kenneth,	C.E.,	Washington, D. C.
Douglass, Norman Engleman,	Ch.E.,	Bethlehem.
Downey, Robert Arthur, Jr.,	Bus.,	Oswego, N. Y.
Drake, William Robert,	C.E.,	Reading.
Durkin, John Keenan,	E.M.,	West Pittston.
Edson, Warren Newton,	M.E.,	Scranton.
Eichelberger, William Sweet,	E.M.,	Saxton.
Emanuel, Robert Samuel,	M.E.,	Nesquehoning.
Ennis, Robert William,	C.E.,	Reading.
Eskew, Arthur Howell,	B.A.,	Asbury Park, N. J.
Evans, Earl Bertram,	C.E.,	Pageton, W. Va.
Fallon, Bernard,	Bus.,	Hartford, Conn.
Feick, Rufus Daniel,	Ch.E.,	Kutztown.
Feuille, Harlan,	C.E.,	Ancon, Panama.
Fink, Donald Goodenough,	Bus.,	Reading.
Fisher, Craig Royston,	B.A.,	Newburyport, Mass.
Fleck, Paul Butler,	E.M.,	Pittsburgh.
Foster, Arthur Lee,	E.E.,	Scranton.
Fox, Edward George,	E.M.,	Pottsville.
Frankois, Joseph,	M.E.,	Nanticoke.
French, Samuel Hooker,	M.E.,	Woodstown, N. J.
Fritzsche, Otto Herbert Adolph,	C.E.,	Irvington, N. J.
Fritz, Donald Wilson,	Bus.,	East Orange, N. J.
Fugate, Howard,	B.A.,	Easton.
Fulmer, Donald Book,	Met.,	Coatesville.
Gallagher, Charles Barto,	B.A.,	Asbury Park, N. J.
Galloway, Beverly Stewart,	B.A.,	Takoma Park, D. C.
Garbarino, Stephen Lawrence,	Bus.,	Shenandoah.
Garcia, Julio Anfonso,	C.E.,	New York, N. Y.
Garra, Edward Joseph,	E.E.,	White Haven.
Gee, Elisha, Jr.,	B.A.,	Denver, Col.

Geho, Charles Henry,	Ch.E.,	Allentown.
Genshart, Fred William Kriebel,	E.M.,	East Mauch Chunk.
Gerhart, Paul Leroy,	E.E.,	Reading.
Gilmour, Edward Holford,	M.E.,	Philadelphia.
Good, Robert Dewalt,	E.M.,	Alelntown.
Gorham, Edward Werrey,	Ch.E.,	Brooklyn, N. Y.
Gorman, Joseph Francis, Jr.,	M.E.,	Allentown.
Gould, Edson Beers, Jr.,	N.E.,	Asbury Park, N. J.
Grace, Carroll Brewster, Jr.,	M.E.,	Philadelphia.
Graessle, Frederick Eugene,	Bus.,	Brooklyn, N. Y.
Graff, Thomas Johnson,	M.E.,	Greenville.
Grambs, George Lorenzo,	B.A.,	Scranton.
Gray, George, Jr.,	M.E.,	Philadelphia.
Greacen, Walter, 3rd,	Bus.,	East Orange, N. J.
Greer, Harry Ross,	B.A.,	Atlanta, Ga.
Grim, James Stewart, Jr.,	E.E.,	Kutztown.
Haefeker, George Augustus,	Ch.E.,	Tamaqua.
Hampton, George,	Ch.E.,	Bridgeton, N. J.
Hanna, William McAfee,	E.E.,	Washington, D. C.
Harman, Edward Hosfield,	E.E.,	New York, N. Y.
Harper, Robert Malcolm,	Bus.,	Butler.
Harris, Frank Leslie,	Met.,	Wilmington, Del.
Harris, Howard Yeager,	B.A.,	Dorranceton.
Hartzell, Richard Wilson,	Met.,	Allentown.
Hauser, Roderick Ritter,	Bus.,	Allentown.
Hauser, Stanley LeRoy,	Met.,	Kutztown.
Hawkins, Richard Arthur,	E.M.,	Forty Fort.
Heckert, Robert Augustus,	B.A.,	Brackenridge.
Heimbrook, Charles Albert,	Bus.,	Bethlehem.
Heller, Clifford Francis,	C.E.,	Stroudsburg.
Henry, Eugene Harvey,	C.E.,	Lancaster.
Henzelman, Carl Franklin,	Bus.,	Easton.
Heske, Walter Gottlieb,	Met.,	Bethlehem.
Hewson, Edward Hashell,	N.E.,	Madison, N. J.
High, Byron Gilbert,	E.E.,	Pottstown.
Hoagland, Dan Parmlee, Jr.,	B.A.,	Bayonne, N. J.
Hoffman, William Jacob,	B.A.,	Raubsville.
Hohl, Joseph Louis,	E.M.,	Catasauqua.
Homeyer, William Henry,	B.A.,	Jersey City, N. J.
Hopkins, John William,	C.E.,	Ambler.
Horton, Ralph Durling,	M.E.,	Andover, N. J.

Hottinger, Alwin Julius,	Met.,	Kenvil, N. J.
Houser, William Earl,	B.A.,	Middletown.
Howser, Sellman,	Ch.E.,	Baltimore.
Huff, Thomas Daniel,	M.E.,	New York, N. Y.
Huggins, William Grenell,	Bus.,	Adams, N. Y.
Hughes, Guy Ingersoll,	Bus.,	Elizabeth, N. J.
Hunter, Francis Alexander,	M.E.,	Hoboken, N. J.
Hutnik, George Joseph,	E.E.,	Wilkes-Barre.
Jamieson, John Jay Ivory,	Met.,	Frackville.
Jamison, Earl Helmes,	E.E.,	Hazleton.
Jenkins, George French,	E.M.,	Binghamton, N. Y.
Jenkins, Mitchell Young,	Ch.E.,	Hanover.
Johnson, Sidney Edward,	Bus.,	Dayton, O.
Jones, George Tyron,	B.A.,	Edwardsville.
Jones, William Harold, Jr.,	Ch.E.,	Asheville, N. C.
Kasper, Ralph Joseph,	N.E.,	Ridgefield, Conn.
Kavanagh, Charles Thomas,	B.A.,	Bayonne, N. J.
Kean, James Gregory,	N.E.,	Lansdowne.
Keefer, Samuel Mumber,	E.E.,	Danville.
Keller, Edwin Walker,	Bus.,	Allentown.
Kemmerer, Walter William,	B.A.,	Wind Gap.
Kerlin, Jackson Lantz,	E.M.,	Philadelphia.
Kichline, William Levi,	B.A.,	Bethlehem.
Kiefer, Hermán Eugene, Jr.,	C.E.,	Quincy, Ill.
Kinney, Joseph Francis, Jr.,	Bus.,	Bethlehem.
Kirchner, Christian,	N.E.,	Baltimore, Md.
Kirchner, Earl Lorenz,	Ch.E.,	Washington, D. C.
Kitchen, John C., Jr.,	Ch.E.,	Columbia, N. J.
Klein, Walter Conrad,	B.A.,	Pottsville.
Klock, John Bees,	E.E.,	Shenandoah.
Kniley, Clifford Leroy,	Bus.,	Tower City.
Koller, Charles Oliver,	E.M.,	New Freedom.
Kern, Raymond Jonas,	M.E.,	Allentown.
Kratz. William,	M.E.,	Baltimore, Md.
Langfitt, James Porter,	B.A.,	Parkersburg, W. Va.
Lau, Zau Ji,	Ch.E.,	Shanghai, China.
Ledoux, Leonard K.,	M.E.,	Swarthmore.
Lee, Charles Benjamin,	Bus.,	Glen Jean, W. Va.
Leh, James Alfred,	Ch.E.,	Catasauqua.
Lester, Harry Vanderburgh,	Ch.E.,	Harrisburg.
Levy, Bertram Rich,	E.E.,	Brooklyn, N. Y.

Lewis, John Herbert,	C.E.,	North Wales.
Light, Berlin Carl,	Ch.E.,	Reading.
Light, Herman Kreider,	N.E.,	Lebanon.
Linaberry, Stanley Simrell,	C.E.,	Columbia, N. J.
Lindo, Donald Joseph,	M.E.,	East Orange, N. J.
Lingle, Charles Fitting,	Bus.,	Harrisburg.
Litke, Harry Theodore,	C.E.,	Millville, N. J.
Lobach, Harry Reginald,	Ch.E.,	Allentown.
Lock, Robert Kenneth,	Met.,	Ashtabula, O.
Logan, Curtis Passavant,	M.E.,	Forty-Fort.
Long, Willoughby James,	Met.,	Bethlehem.
Lord, Edward Thomas Warren,	Ch.E.,	Philadelphia.
Lozano, Hector,	Ch.E.,	Nuevo Leon, Mexico.
Luce, Donald Cameron,	E.E.,	Scranton.
Lundberg, George Otto,	M.E.,	Lansing, Mich.
Lutz, James Frank,	Bus.,	Hazleton.
Lynch, Frank Elijah, Jr.,	M.E.,	Delmar, Del.
MacKenzie, Adrian Morell,	Bus.,	Englewood, N. J.
McBride, John Leo,	B.A.,	Phillipsburg, N. J.
McBride, Joseph Aloysius,	M.E.,	Philadelphia.
McCartney, John Lincoln, Jr.,	Bus.,	Crafton.
McElvain, Clarence Newton,	Bus.,	Red Oak, Ia.
McFadden, John Joseph,	E.E.,	Allentown.
McIntire, Robert Lester,	M.E.,	Butler.
Mack, Edwin Laverne,	E.E.,	Allentown.
Mackenzie, Sidney Thompson,	N.E.,	Philadelphia.
Maguire, Joseph Anthony,	B.A.,	Vineland, N. J.
Major, William Samuel,	Ch.E.,	Roebling, N. J.
Malloy, Daniel Joseph,	B.A.,	Freeland.
Mandell, Leon Nathaniel,	Ch.E.,	Philadelphia.
Manley, Herbert Waldo,	B.A.,	Canton.
Mann, Morgan MacMorries,	Met.,	New York, N. Y.
March, Eugene Royer,	Bus.,	Philadelphia.
Markle, Oswald Luke,	Ch.E.,	Hanover.
Martin, Frederic Thurman,	Ch.E.,	Harrisburg.
Master, Warren S.,	E.E.,	Reading.
Maust, George Johnson,	Bus.,	St. Augustine, Fla.
Melniker, Edward Joseph,	B.A.,	Bayonne, N. J.
Metzner, Russell Henry,	M.E.,	Wheeling, W. Va.
Meyer, William Charles,	E.E.,	Bethlehem.
Miller, Philip Robert,	B.A.,	Bethlehem.
Miller, Walter Hurxthal, Jr.,	E.M.,	Glendale, O.

Milligan, John Ralph,	Bus.,	East Liverpool, O.
Minister, Pemberton Foster,	B.A.,	Bristol.
Mitchell, Charles Bayard,	E.M.,	Woodbury, N. J.
Mixsell, Edwin Leighton,	Met.,	Bethlehem.
Moore, Myron T.	Bus.,	Youngstown, O.
Moorhead, Albert Donald,	Met.,	Indiana.
Morgan, Josiah Dodson,	E.E.,	Reading.
Myers, John Alfred,	M.E.,	York.
Neely, Curll Lockwood,	Ch.E.,	Foxburg
Newell, Howard Laurens,	Bus.,	West Carrolton, O.
Newhard, Paul Aaron,	Bus.,	Northampton.
Northup, Maynard Sanbon.	Met.,	Allentown.
Nuss, Raymond Victor,	C.E.,	Bethlehem.
O'Brien, William Henry,	Bus.,	Lynbrook, N. Y.
Palmer, William Francis,	Ch.E.,	Reading.
Panckere, Francis Joseph,	E.M.,	Lansford.
Parker, Joseph Henry,	Bus.,	Milwaukee, Wis.
Parker, William Alden,	M.E.,	Haverford.
Parsons, Donald Adelbert,	M.E.,	New Rochelle.
Patterson, Daniel Walter,	C.E.,	Bethlehem.
Patterson, John Alexander,	Ch.E.,	Philadelphia.
Paxton, George Benjamin,	E.E.,	Harrisburg.
Pearson, Frederick Joseph,	B.A.,	Wilkes-Barre.
Penwell, Max Kenneth,	E.M.,	Pana, Ill.
Person, Wilbur William,	E.M.,	Weissport.
Phillips, Hugh Joseph,	C.E.,	Red Bank, N. J.
Pierson, Albert Closson,	B.A.,	Lititz.
Platt, Ellis Halsted,	Bus.,	Bethesda, Md.
Pomfret, Robert Wallace,	M.E.,	Richmond Hill, N. Y.
Poor, Arthur Grimes,	E.E.,	Passaic, N. J.
Quinlan, Eldridge Edward,	Bus.,	Newark, N. J.
Ratajczak, Frank Xavier,	B.A.,	Reading.
Reams, Louis Milton,	M.E.,	Richmond, Va.
Reese, Benjamin Harvey,	N.E.,	Dorranceton.
Reilly, John Kennedy,	Bus.,	Spangler.
Reyer, William Aaron,	Ch.E.,	Northampton.
Rice, Charles Lewis,	C.E.,	Hazleton.
Rice, Janvier Mayhew,	M.E.,	Bridgeton, N. J.
Rich, Bernard Arthur,	E.E.,	Harrisburg.
Richards, Louis Moore,	M.E.,	Somerville, N. J.
Richardson, Edward Hardy,	C.E.,	Malvern.

Ritter, Ralph Shelly,	M.E.,	Quakertown.
Roberts, Arthur Parsons,	Bus.,	Englewood, N. J.
Robinson, Edmund Lewis,	E.E.,	Bethlehem.
Robinson, Harry George,	M.E.,	Trenton, N. J.
Robinson, John Mealy,	M.E.,	Pittsburgh.
Robinson, James Wood,	E.M.,	Shanghai, China.
Rogers, Henry Gordon,	Ch.E.,	Newark, N. J.
Rogers, John Frederick,	Bus.,	Buffalo, N. Y.
Rohrbach, Kenneth Loris,	Ch.E.,	Bethlehem.
Rohrer, Henry Augustus,	M.E.,	Lancaster.
Ross, Jack Elton,	C.E.,	Newark, N. J.
Roth, Harry Levyston,	Ch.E.,	Allentown.
Roth, Milton Samuel,	M.E.,	Butler.
Rouch, Ernest Allen,	M.E.,	York.
Russell, Charles Ellis,	E.E.,	Philadelphia.
Ruttenberg, Benjamin F.	Bus.,	Reading.
Ryan, Michael Joseph, Jr.,	Met.,	Bethlehem.
Sanchez, Waldino Diaz,	E.M.,	Bethlehem.
Sanford, James Leo,	C.E.,	Long Beach, N. Y.
Sattenstein, Sidney Lincoln,	E.E.,	Reading.
Sayre, Austin Bartholomew,	C.E.,	Glen Ridge, N. J.
Schaeffer, Harry Joseph,	Ch.E.,	Bethlehem.
Schaffer, George Washington,	Met.,	Allentown.
Scheetz, Edwin Freed,	E.M.,	Wyncote.
Schleicher, Wallace Mengel,	N.E.,	Maplewood, N. J.
Schlegel, Arthur Ordmon,	M.E.,	Reading.
Schoenfeld, Lester Wolfson,	E.E.,	Philadelphia.
Schreier, Harry,	Bus.,	New York, N. Y.
Schuler, Norman Edward,	Met.,	Bethlehem.
Schultz, Albert Novinger,	E.E.,	Williamsport.
Schwartz, Paul Englebert,	Bus.,	Harrisburg.
Scott, William Alexander,	N.E.,	New York, N. Y.
Seem, John Derr,	Met.,	Allentown.
Seideman, Sidney,	Bus.,	Philadelphia.
Serfass, Clayton Adam,	M.E.,	Colebrook, N. H.
Sheaffer, Amos Paul,	M.E.,	Lancaster.
Sheldon, Alan Forbes,	M.E.,	New Rochelle, N. Y.
Shields, Donald Sloan,	Bus.,	Ridgewood, N. J.
Shigo, John Joseph, Jr.,	B.A.,	Freeland.
Sidler, Robert Simington,	E.M.,	Sunbury.
Simmons, John Stegner,	E.M.,	Scranton.

Simpson, Harold Emerson,	Bus.,	Indiana.
Skolnick, Leonard,	Chem.,	Newark, N. J.
Smith, Theodore Boyd,	E.M.,	Middletown, N. Y.
Snyder, Frederick Deppen,	Ch.E.,	Harrisburg.
Snyder, Gehrad, 3rd,	Met.,	Bloomsburg.
Sobel, Sidney Amos,	Bus.,	Erie.
Springsteen, Arthur W.,	B.A.,	Detroit, Mich.
Springsteen, William,	Bus.,	Detroit, Mich.
Stahl, Frederick Glenn,	E.E.,	Bethlehem.
Stauffer, Edwin Lewis,	Ch.E.,	Northampton.
Stelle, Kenneth Lawrence,	E.M.,	Jamaica Plain, Mass.
Stern, Paul Hertzler,	B.A.,	Elizabethtown.
Stille, Francis Carroll,	E.M.,	Woodbury, N. J.
Straub, Lewis Boyd,	Bus.,	Pittsburgh.
Strawn, Eli Howard,	C.E.,	Quakertown.
Sutherland, Falkner,	Bus.,	LeRoy, N. Y.
Swartley, John Cassel, Jr.,	B.A.,	Doylestown.
Swartz, Ralph Christian,	M.E.,	Allentown.
Tatum, Chauncey Roland,	M.E.,	Baltimore, Md.
Tenney, Edward Andrews,	C.E.,	Vineland, N. J.
Thompson, Edward King,	M.E.,	Pittsburgh.
Thompson, John Shirreffs,	B.A.,	Auburn.
Thompson, Walter Scott,	E.E.,	Sunbury.
Thorp, Leo Joseph,	M.E.,	Rockville Centre, N. Y.
Tinsman, Howard Riegel,	M.E.,	Phillipsburg, N. J.
Toms, Charles Lawrence,	Ch.E.,	Morristown, N. J.
Tonking, Russell,	Ch.E.,	Dover, N. J.
Tremaine, Lawrence,	M.E.,	Buffalo, N. Y.
Troland, Hugh Moore, Jr.,	C.E.,	Philadelphia.
Troutman, Roy Ezra,	Ch.E.,	Tulpehocken.
Tuggey, John Mitchell, Jr.,	B.A.,	Bethlehem.
Underwood, Lloyd Fletcher,	Ch.E.,	Brooklyn, N. Y.
Underwood, Ralph Edward,	M.E.,	Brooklyn, N. Y.
Unkles, John Jacob,	Bus.,	East Orange, N. J.
Urban, Stanley Joseph,	E.M.,	Allentown.
Van Dyke, John Harrison,	M.E.,	Pittsburgh.
Vines, Norman Bowden,	Ch.E.,	New York, N. Y.
Waller, John Felix,	Ch.E.,	Allentown.
Walter, Ephraim Kenneth,	Bus.,	Brooklyn, N. Y.
Warriner, Ruel Dexter,	E.M.,	Philadelphia.
Wasser, Floyd Henry,	Met.,	Bethlehem.

Watkins, John Edward,	M.E.,	West Hazleton.
Wehr, Mentzer Russell,	E.E.,	Denver.
Wentz, Graham,	Ch.E.,	Scranton.
White, Charles McCrea,	C.E.,	Wilmington, Del.
Wiegner, Andrew Newton,	C.E.,	Bethlehem.
Wigfall, Edward Newton, Jr.,		Philadelphia.
Wilbur, Warren Packer,	C.E.,	Bethlehem.
Wilkins, Julian Chapman,	C.E.,	Baltimore, Md.
Wing, Francis Henry,	Bus.,	Boston.
Wise, James Andrew,	B.A.,	Hopeville, Ga.
Wood, Arthur,	B.A.,	Providence, R. I.
Wood, Charles Bradley,	N.E.,	Bellevue.
Wood, Frederic Turnbull,	Ch.E.,	Philadelphia.
Woodford, Walter Fletcher,	E.E.,	Nutley, N. J.
Woodrow, Maurice O.,	C.E.,	Wilkes-Barre.
Woolridge, William Porter,	M.E.,	Pittsburgh.
Yates, Richard Crawford,	Bus.,	Buffalo, N. Y.
York, Elbert Hower,	E.E.,	Scranton.
York, Warren Webster,	Bus.,	Scranton.
Yu, Chia-Ku,	E.E.,	Kiangsi, China.
Yundt, George Edward,	E.M.,	Allentown.
Zannaras, John Philippe,	N.E.,	Chios, Greece.
Zantzinger, Otway Berryman, Jr.,	Bus.,	Hyattsville, Md.

SPECIAL STUDENTS

	Course	Residence
Beatty, Seth Keeney,	Bus.,	Wilkes-Barre.
Benz, Paul Frederick,	Ch.E.,	Haledon, N. J.
Daughtrey, Guy Darrell,	N.E.,	Waco, Tex.
Goldberg, Solomon,	Chem.,	Pilwischky, Russia.
Hsu, Tsung-Chee,	C.E.,	Soochow, China.
Kinsey, Irwin Zipp,	B.A.,	Souderton.
Litz, Dominick,	Bus.,	San Giovanni, Italy.
Long, Robert R.,	E.M.,	Ashland.
Lund, Gosse Clarence,	B.A.,	Berlin, Conn.
MacDonald, Harry Colin,	Bus.,	Williamsport.
McKenzie, Carl Harry,	Bus.,	Dallas, Tex.
Ma, Chien. Chung,	Ch.E.,	Samarang, Java.
Mangala, Phon Jaya,	C.E.,	Debsirindra, Siam.

Miller, Harry Bachman,	Bus.,	Bethlehem.
Morgan, William John,	Bus.,	Bethlehem.
Parlour, Clarence Henry,	B.A.,	Allentown.
Rhoads, Byron Elmer, Jr.,	C.E.,	Big Stone Gap, Va.
Ricapito, Joseph,	Bus.,	Bethlehem.
Smith, Harradon H.,	Geol.,	Bethlehem.
Wong, Chii Fun,	E.M.,	Huosium, China.
Ziegenfuss, Charles Edwin,	Bus.,	Bethlehem.
Zinszer, Harvey Alfred,	B.A.,	Allentown.

STUDENTS IN EVENING COURSES IN NAVAL ARCHITECTURE

The following list includes non-matriculated students who are taking evening courses in Naval Architecture and Marine Engineering described on pages 133-134. The courses in which the students are enrolled are indicated by numbers: 1, Elements of Naval Architecture; 2, Elements of Strength of Materials; 3, Elements of Steam Power.

	Course	Residence
Anderson, William Coull,	2	Bethlehem.
Artis, Albert Edward,	3	Bethlehem.
Bass, Walter,	2, 3	Bethlehem.
Buchenheu, Harry,	1	Bethlehem.
Calcutt, George Frederick,	2, 3	Bethlehem.
Elderkin, Arthur Thomas,	2, 3	Bethlehem.
Gross, David Beecher,	1, 2	Bethlehem.
Gunville, Francis Daniel,	2, 3	Bethlehem.
Hackett, Thomas James,	2	Bethlehem.
Hanson, August Olaf,	2	Bethlehem.
Hebble, Chester Mackey,	2, 3	Bethlehem.
Hodge, William Ernest,	2, 3	Allentown.
Issbrucker, Carl William,	1	Bethlehem.
Jolly, William Henry,	1, 2, 3	Bethlehem.
Jones, Harold Nichols,	1, 2	Bethlehem.
Lockwood, Edward Mead,	2	Bethlehem.
Manning, Frederick William,	1	Bethlehem.
Mark, Carl Frank,	2, 3	Catasauqua.
Nelson, Daniel Reimert,	1	Bethlehem.
Ohlson, Paul Otto,	2, 3	Bethlehem.
Peterson, Thoralf Roh,	1, 2	Bethlehem.
Pinel, Roland Hammond,	1	Bethlehem.
Reitzel, James Garret,	2, 3	Bethlehem.

Rosa, Leo Chester,	2, 3	Bethlehem.
Safka, Joseph Charles,	2, 3	Bethlehem.
Semprini, Edgar,	2	Allentown.
Scott, William Jones,	3	Bethlehem.
Sheehan, Richard White,	2, 3	Bethlehem.
Storey, George Booth,	2	Bethlehem.
Thomas, Wesley Courtland,	2, 3	Easton.
Tufts, Russell Daniel,	2, 3	Bethlehem.
Werley, Richard Elias,	1	Allentown.
Yama, Arthur,	1	Bethlehem.
Youngquist, Alvin,	2, 3	Bethlehem.

STUDENTS IN EVENING SCHOOL OF BUSINESS ADMINISTRATION

The following list includes non-matriculated students who are pursuing courses in the Evening School of Business Administration, described on pages 131-132. The courses in which the students are enrolled are indicated by numbers: 1, Business Law; 2, Banking and Currency; 3, Accounting; 4, Economics.

NAME	COURSE	RESIDENCE
Bader, Harry Walker,	1, 2, 3	Bethlehem.
Baer, John G.,	1, 2, 3, 4	Allentown.
Bean, Roscoe D.,	1, 2, 3	Bethlehem.
Beyer, Carl F. W.,	1, 2, 3, 4	Bethlehem.
Brady, Frank J.,	1, 2, 3	Bethlehem.
Browd, Irwin R.,	1, 2, 3, 4	Bethlehem.
Childs, George Lawton,	3	New York, N. Y.
Childs, Raymond Austin,	3	New York, N. Y.
Cole, Franklin,	1, 2, 3, 4	Bethlehem.
Cressman, Grant J.,	1, 2, 3, 4	Bethlehem.
Dennis, Charles W.,	1, 2, 3	Bethlehem.
Ditterline, Roy E.,	1, 2, 3, 4	Bethlehem.
Doggett, Egbert B.,	1, 2, 3, 4	Bethlehem.
Eberhart, Isaac K.,	1, 2, 3, 4	Bethlehem.
Felker, William H.,	1, 2, 3, 4	Bethlehem.
Finkle, Ralph,	1, 2, 3	Allentown.
Foote, Marshall H.,	3	So. Norwalk, Conn.
Friedman, Jacob,	1, 2, 3, 4	Bethlehem.
Gasda, Stephen A.,	1, 2, 3, 4	Bethlehem.
Glace, William W.,	1, 2, 3	Bethlehem.
Groman, Harold E.,	1, 2, 3, 4	Bethlehem.

Haehnle, Edward D.,	1, 2, 3	Bethlehem.
Hartzell, Ralph,	3	York.
Herrington, A. S.,	3	Latrobe.
Hoffman, George E.,	1, 2	Bethlehem.
Hoffner, Bernard C.,	1, 2, 3	Bethlehem.
Huffman, Milton K.,	1, 2, 3, 4	Bethlehem.
Hughart, William O.,	1, 2, 3, 4	Grand Rapids, Mich.
Judd, Merritt F.,	1, 2, 3, 4	Bethlehem.
Kanuck, John A.,	1, 2, 3, 4	Bethlehem.
Keeler, Austin E.,	1, 2, 3, 4	Bethlehem.
Kilpatrick, Laurence A.,	1, 2, 3, 4	Bethlehem.
Knodler, LeRoy Francis,	3	Bethlehem.
Kunkel, Luther G. N.,	1, 2, 3, 4	Allentown.
Lyon, William H.,	1, 2, 3, 4	Bethlehem.
MacGregor, Louis J.,	1, 2, 3, 4	Allentown.
McGlade, William J.,	3	Allentown.
Machado, José A., Jr.,	1, 2, 3	Bethlehem.
Millar, Edward A., Jr.,	1, 2, 3, 4	Bethlehem.
Miller, Henry Charles,	1, 2, 3, 4	Bethlehem.
Moore, Alfred Warren,	2	Bethlehem.
Myers, Ralph S.,	1, 2, 3, 4	Bethlehem.
O'Donnell, John J.,	1, 2, 3, 4	Bethlehem.
Parrish, John Leo,	1, 2, 3	Bethlehem.
Peffer, Samuel T.,	1, 2, 3, 4	Bethlehem.
Quier, Walter Charles, Jr.,	1, 2, 3	Bethlehem.
Ramsay, John G.,	1, 2, 3, 4	Bethlehem.
Risser, Earl Thomas,	1, 2, 3, 4	Bethlehem.
Rogers, William Joyce,	1, 2, 3, 4	Bethlehem.
Rosewarne, Charles H.,	2, 4	Bethlehem.
Ruyak, George J.,	1, 2, 3, 4	Bethlehem.
Schaffer, Earl E.,	1, 2, 3, 4	Bethlehem.
Scholl, Clifford Milton,	1, 2, 3, 4	Allentown.
Smith, Samuel R.,	1, 2, 3, 4	Bethlehem.
Snyder, Martin F.,	1, 2, 3, 4	Bethlehem.
Snyder, Robert N.,	1, 2, 3	Bethlehem.
Toohey, William J.,	2	Bethlehem
Weiser, Grant,	1, 2, 3, 4	Hellertown.
Wetterau, Charles Henry,	2	Bethlehem.
Yeager, Stanley E.,	1, 2, 3, 4	Hellertown.
Boynton, Henry G.,	3	New York, N. Y.
Zimmerman, Eugene M.,	3	Bethlehem.

STUDENTS IN EXTENSION COURSES

The following list includes non-matriculated students who are pursuing collegiate or postgraduate courses from among those listed on pages 125-130 of this Register. In addition, candidates for the Master's degree who have also enrolled in such extension classes are included in the list of extension students. The letter G after the student's name indicates that the work he is pursuing is recognized to be of graduate character.

The courses in which the students are enrolled are indicated by numbers as follows: 1, General Biology; 2, Education of the Defective and Abnormal; 3, Demonstration in the Education of the Defective; 4, Educational Measurements; 5, Occupational Therapy; 6, Project Method; 7, School Administration; 8, Public Speaking; 9, French; 10, Geology; 11, Mental Diagnosis; 12, Mental Hygiene; 13, Mental Clinic; 14, Social Psychology; 15, Spanish; 16, Educational Dramatics; 17, Logic.

SUMMER SESSION, 1920

	COURSE	RESIDENCE
Babcock, Mary,	11, 12, 13,	Bethlehem.
Barner, Richmond Bryan,	9, 11, 14,	Kutztown.
Bishop, Louise Antoinette, A,B.,	3, 5,	Bethlehem.
Diecks, Ella,	2, 5, 11, 12,	Hackensack, N. J
Eichman, Caroline,	2, 5, 11, 12, 16	Easton.
Dimmick, Pearl Anna,	9, 16,	Hellertown.
Dwyer, Mary,	11, 12,	Bethlehem
Fink, Marjorie,	16,	Bethlehem.
Gavin, Emma C.,	11, 12,	Bethlehem
Gelpke, Mary Catherine,	11, 12, 14, 16,	Phillipsburg N. J.
Grime, Regina Christina,	9, 16,	Bethlehem.
Harmon, Neva M.,	5, 12, 13, 14,	Phillipsburg, N. J.
Hartzell, Ada K.,	2, 12, 13,	Harrisburg.
Hale, Edna Mae,	2, 3, 5, 11, 12,	Mahanoy City.
Hillard, Barbara E.,	2, 3, 5, 13,	Harrisburg.
Jacobs, Homer Miller, Ph.B.,	12, 13, 16,	Norristown.
Muth, William Edward,	15,	Pen Argyl.
Nichols, Elizabeth Melvin,	2, 11, 12, 16,	Easton.
Nolf, Laura A.,	3, 5,	Center Valley.
Patterson, Arthur C.,	9, 15, 16,	Philadelphia.

Pelzel, Helene,	2, 5, 13,	Harper.
Pohl, Elizabeth Shimer,	2, 5, 11, 12, 16,	Easton.
Ringleben, August Andrew, A.B.,	11, 12, 14,	Hazleton.
Rundle, Jessie Mae,	2, 11, 12, 16,	Easton.
Scott, Rachel M.,	2, 11, 12, 16,	Easton.
Scott, Rosa Elizabeth,	2, 11, 12, 16,	Easton.
Villee, Sallie H.,	5, 11, 12, 13,	Bethlehem.
Webber, Clella,	2, 5, 13,	Ozark, Mo.
Welch, Marion Esther,	11, 12, 13,	Bethlehem.
Whitney, Sarah May,	2, 5, 11, 13,	Fitchburg, Mass.

FIRST TERM, 1920-1921

	COURSE	RESIDENCE
Adams, Cora,	6,	Harrisburg.
Albright, Denton M., A.B.,	6, 14,	Harrisburg.
Allen, Constance,	1,	Bethlehem.
Allen, Dorothy,	1,	Bethlehem.
Allen, Elsie,	11,	Frankford.
Alleman, Catherine,	6,	Harrisburg.
Amrheim, Virginia,	1,	Bethlehem.
Anderson, Mabel,	11,	Atlantic City, N. J.
Armpriester, Helen,	6,	Harrisburg.
Arnold, Herbert Franklin, A.B.,	4, 8,	Easton.
Asper, Elda Mae,	6,	Harrisburg.
Atkinson, Mary C.,	12,	Atlantic City, N. J.
Aughenbaugh, Margaret Louise,	6,	Harrisburg.
Ayers, Mrs. Roy,	12,	Atlantic City, N. J.
Baas, Florence E.,	11, 17,	Bethlehem.
Babcock, Mary Kirk,	13,	Bethlehem.
Bachman, Charles Clinton, A.B.,	6, 14,	Allentown.
Bachman, Mary E.,	4,	Phillipsburg, N. J.
Baker, Elizabeth S.,	6,	Harrisburg.
Balsley, Catherine Marie,	6,	Harrisburg.
Banks, Helen Whitney,	6,	Harrisburg.
Barthol, Preston C.,	8,	Bethlehem.
Baskin, Caroline,	6,	Harrisburg.
Bates, Lena May,	11,	Pleasantville, N. J.
Beattie, Marjorie, A.B.,	11,	Philadelphia.
Beckwith, Florence,	4,	Phillipsburg, N. J.
Beers, Ida,	4,	Phillipsburg, N. J.

Benfield, Charles E.,	6,	Allentown.
Bentzel, Edith M.,	6,	Harrisburg.
Bentzel, Flora B.,	6,	Harrisburg.
Bergin, Emilie E.,	8,	Easton.
Bergstresser, J. L.,	8,	Bethlehem.
Bett, Helen,	6,	Hazleton.
Bieber, Agnes L.,	8,	Phillipsburg, N. J.
Bigelow, Eva,	4,	Phillipsburg, N. J.
Billow, Milton Oscar, A.B.,	6, 14,	Harrisburg.
Bishop, Louise Antoinette, A.B.,	13,	Bethlehem.
Bishop, Sarah Emily, A.B.,	6, 13,	Bethlehem.
Boyer, Orpha Curry,	4,	Phillipsburg, N. J.
Brabson, Violet L.,	8,	Easton.
Breen, Etta,	4,	Phillipsburg, N. J.
Bresee, Harriet M.,	11,	Atlantic City, N. J.
Broadbent, Earl L.,	11,	Philadelphia.
Broome, Mary,	11,	Bethlehem.
Brown, Elizabeth,	11,	Easton.
Brown, Charles Welker, C.E.,	8,	Bethlehem.
Brown, Clara Josephine,	6,	Harrisburg.
Bruce, Janet E.,	11, 17,	Bethlehem.
Brunner, William Albert, A.B.,	6, 14,	Harrisburg.
Burkholder, Mary Elizabeth,	6,	Harrisburg.
Burke, Helen,	6,	Bethlehem.
Burwell, Linnie M.,	8,	Phillipsburg.
Bush, Frank Royce,	8,	Bethlehem.
Butz, Nelson M.,	14,	Allentown.
Carl, D. M.,	8,	Bethlehem.
Campbell, E. Alva,	12,	Philadelphia.
Carroll, Clara,	1,	Bethlehem.
Carroll, John H.,	10,	Easton.
Child, Florence C., M.D., Ph.D.,	13,	Philadelphia.
Child, Dorothy, M.D., Ph.D.,	13,	Philadelphia.
Child, Nina G.,	11,	Philadelphia.
Clemens, R. A.,	11,	Atlantic City, N. J.
Clifton, Henrietta,	11, 13,	Philadelphia.
Clouser, Ann G.,	6,	Harrisburg.
Cody, Mary A.,	4,	Phillipsburg, N. J.
Coleman, R. Emma,	6,	Harrisburg.
Collins, Laura E.,	11,	Pleasantville, N. J.

Compton, Alma Gertrude,	4, 8,	Easton.
Connell, J. B.,	8,	Bethlehem.
Connolly, Mary,	8,	Phillipsburg, N. J.
Cook, Harold Earl,	8,	Phillipsburg, N. J.
Cooper, Anne Lewis, A.B.,	11,	Atlantic City, N. J.
Cooper, Carol C.,	8,	Phillipsburg, N. J.
Cortelyou, Frank D.,	4,	Washington, N. J.
Coyle, W. Radford,	8,	Bethlehem.
Crane, Mary Evelyn,	6,	Harrisburg.
Crittenden, E. Madge,	11,	Bradford, N. H.
Crobaugh, Marie L.,	1, 17,	Easton.
Cross, Thomas J.,	12,	Atlantic City, N. J.
Crowl, Anna Virginia,	6,	Harrisburg.
Dailey, Hattie,	4,	Phillipsburg, N. J.
Danner, Muriel,	1,	Bethlehem.
Davis, Annie,	4,	Phillipsburg, N. J.
DeYoung, Mrs. Rosa Stein,	11,	Overbrook.
Ditton, Anna Louise,	4,	Phillipsburg, N. J.
Dick, Dorothy K.,	8,	Phillipsburg, N. J.
Ditton, Mary,	4,	Phillipsburg, N. J.
Dodson, Alan Craig, B.S.,	8,	Bethlehem.
Dodson, Truman Monroe, B.S.,	8,	Bethlehem.
Dreifoos, Hattie,	6,	Allentown.
Dreisbach, Matilda V.,	8,	Phillipsburg, N. J.
Dressor, Chauncey E., D.D.S.,	8,	Bethlehem.
Dugan, Cora E.,	6,	Harrisburg.
Durnin, Cecelia,	6,	Allentown.
Dwyer, Mary M.,	6, 13,	Bethlehem.
Early, Stella Stewart,	6,	Harrisburg.
Ehrgott, W. F.,	8,	Bethlehem.
Eliason, Mary Ethel,	11,	Hollidaysburg.
Elliott, Mrs. Mary Fiske,	4,	Phillipsburg, N. J.
Ewart, Carrie B.,	11,	Longport, N. J.
Fairlamb, Mary Eleanor,	11, 12,	Philadelphia.
Faust, Paul Bertrand, B.S.,	6, 14,	Harrisburg.
Fautchey, Laura,	6,	Harrisburg.
Fegeley, Solon J., A.B.,	14,	Allentown.
Fenton, Hattie,	11,	Atlantic City, N. J.
Ferguson, Bertha S.,	6,	Harrisburg.
Ferguson, J. Frazier,	6,	Harrisburg.

Fetherolf, Martin D., B.A.,	14,	Allentown.
Findlay, Laura H.	6,	Allentown.
Findley, Helen G.,	13,	Philadelphia.
Finton, Marie J.,	6,	Harrisburg.
Fisher, Clara May,	6,	Harrisburg.
Fitzimons, Lillian,	6,	Harrisburg.
Fitzpatrick, Florence,	11,	Philadelphia.
Flynn, Mary A.,	8,	Philadelphia.
Foley, Jessie Romig,	6,	Allentown.
Frame, Christine D.,	8,	Phillipsburg, N. J.
Frank, Celia,	12,	Philadelphia.
Frederick, Laura A.,	11,	Easton.
Frey, Clifford Foster,	8,	Bethlehem.
Friedlander, Sarah, A.B.,	14,	Allentown.
Fritsch, J. Warren,	14,	Allentown.
Fulmer, Kathryn Rose,	11,	Easton.
Fulper, Blanche Titus,	8,	Phillipsburg, N. J.
Fulper, Emma Walton,	4,	Stewartsville.
Funk, M. Estella,	11,	Philadelphia.
Gamble, Maude J.,	6,	Harrisburg.
Gannon, Elizabeth G.,	11,	Atlantic City, N. J.
Gayman, Paul S.,	10,	Easton.
Gebhard, M. Arline,	11, 17,	Bethlehem.
Geidner, Dorothy M.,	6,	Allentown.
Gelpke, Mary Catherine,	13,	Phillipsburg, N. J.
Gifford, John Warren,	11,	Pleasantville, N. J.
Gilchrist, Jessie L., A.B.,	11,	Atlantic City, N. J.
Gilroy, Ada E.,	8,	Phillipsburg, N. J.
Glasier, J. Arthur, B.D.,	11, 17,	Bethlehem.
Goldsmith, Elizabeth S.,	6,	Harrisburg.
Goetz, George Herman,	6,	Harrisburg.
Good, Grace,	11,	Pleasantville, N. J.
Goodman, Howard E.,	8,	Bethlehem.
Gordown, Agnes B.,	8,	Phillipsburg, N. J.
Gray, Viola M.,	13,	Philadelphia.
Grove, LaVene,	6,	Harrisburg.
Grubb, Percy Lamar, B.A.,	6. 14,	Harrisburg.
Guyer, J. Pierce,	8,	Bethlehem.
Hager, Anna Loise,	4,	Phillipsburg, N. J.
Haifleigh, Catherine,	6,	Harrisburg.

Hake, Mrs. Edith Thomas,	6,	Harrisburg.
Hall, Mabel Santavieve,	6,	Harrisburg.
Hamaker, Gertrude E.,	6,	Harrisburg.
Hammell, Ethel C.,	12,	Atlantic City, N. J.
Hanlon, Mary Dorothy,	6,	Allentown.
Hardy, Helen Elizabeth,	8,	Easton.
Harmon, Neva M.,	8, 13,	Phillipsburg, N. J.
Harris, Anna Pauline,	6,	Harrisburg.
Harris, Eulalia A.,	8,	Phillipsburg, N. J.
Harris, Minnie C.,	8,	Phillipsburg, N. J.
Hartman, Fred B.,	8,	Bethlehem.
Hassler, Mrs. Helen A.,	6,	Harrisburg.
Heiges, Walter C.,	6,	Harrisburg.
Helfrich, Emory W.,	11,	Pleasantville, N. J.
Henschen, George N. C., A.B.,	6, 14,	Harrisburg.
Henry, Margaret Lee,	12,	Atlantic City, N. J.
Hepford, Minerva S.,	6,	Harrisburg.
Hoagland, Ada May,	11, 12,	Atlantic City, N. J.
Hocker, Peter L.,	6,	Harrisburg.
Hoere, Herman W.,	8,	Bethlehem.
Hofford, Hilda Naomi,	1, 10, 11,	Allentown.
Hoffsommer, Mabel Olive,	6,	Harrisburg.
Hook, Clara H.,	6,	Harrisburg.
Housekeeper, M. A.,	11,	Philadelphia.
Hoover, Ruth M.,	6,	Harrisburg.
Houser, Lillian M.,	4, 6,	Phillipsburg, N. J.
Howard, Joseph A., B.Sc.,	11,	Pleasantville, N. J.
Huber, Gertrude,	6,	Harrisburg.
Huber, Katherine Fern,	6,	Harrisburg.
Huber, Marion Christ,	1, 11,	Bethlehem.
Huhn, Anna Miriam,	8,	Easton.
Huhn, Blanche Alice,	8,	Easton.
Hulsizer, Margaret Alice,	8,	Easton.
Hummer, Miles C.,	6,	Harrisburg.
Ingersoll, Charles Wesley, M.S.,	11,	Pleasantville, N. J.
Jacoby, Clinton B.,	8,	Bethlehem.
Kahler, Bertha M.,	8,	Phillipsburg, N. J.
Kane, George,	8,	Phillipsburg, N. J.
Karsch, Karl H.,	6, 7, 14,	Allentown.
Kast, Bessie Edna, B.A.,	6, 14,	Harrisburg.

Keiper, Edward Detweiler,	6,	Harrisburg.
Keiter, Annie R.,	6,	Harrisburg.
Kennedy, Mary M.,	6,	Harrisburg.
Kenney, Caleb Samuel, C.E.,	10,	Bethlehem.
Kern, Nelson Eugene,	14,	Allentown.
Kessler, Harvey W.,	8,	Bethlehem.
Kessler, Rosa M.,	14,	Allentown.
King, Corinne,	11,	Pleasantville, N. J.
King, Franklin G.,	8,	Bethlehem.
Kistler, Alfarata P.,	6,	Allentown.
Kittredge, Harold Woodworth,	11,	Atlantic City, N. J.
Klavans, Leah Florence,	6,	Harrisburg.
Kleckner, Ruth Emma,	10,	Bethlehem.
Knox, Elizabeth Stewart,	6,	Harrisburg.
Koons, Caroline Elizabeth,	6,	Allentown.
Koser, Josephine R.,	6,	Harrisburg.
Kob, John F.,	6,	Harrisburg.
Krall, Helen,	6,	Harrisburg.
Kreider, Minerva M.,	6,	Harrisburg.
Kressler, Ray H.,	6, 14,	Allentown.
Kressler, Helen Roseberry,	6,	Finesville, N. J.
Lake, Mrs. Flora G.,	4, 8,	Phillipsburg, N. J.
Landis, Adele M.,	1,	Coopersburg.
Lamberton, Mary,	4,	Easton.
Laubach, Pauline Elizabeth,	1,	Easton.
Lawton, Grace Evelyn,	12,	Philadelphia.
Leaman, Ruth,	6,	Allentown.
Leeds, Abbie M.,	11,	Somers Point, N. J.
Leeds, Nettie C.,	11,	Somers Point, N. J.
Leiby, Mary Esther,	6,	Allentown.
Lentz, Hazel Irene,	6,	Harrisburg.
Lerch, Raymond,	4,	Phillipsburg, N. J.
Lesher, Mrs. Edith,	4,	Phillipsburg, N. J.
Leswing, Joseph, M.A.,	14,	Harrisburg.
Lewis, Mary C.,	12,	Philadelphia.
Lewis, Mrs. W. P.,	8,	Phillipsburg, N. J.
Lindsay, Moses Alexander, M.A.,	6,	Harrisburg.
Loosbach, Elizabeth,	10,	Allentown.
Lopp, Mildred,	10,	Bethlehem.
Lott, Margaret Geraldine,	4,	Phillipsburg, N. J.

Lucas, Marjorie,	12,	Philadelphia.
Luckenbach, Martha,	1,	Bethlehem.
Luria, Pauline L.,	11, 12, 13,	Philadelphia.
Lynch, Mary Adelaide,	4,	Phillipsburg, N. J.
MacAlister, Nan,	11,	Philadelphia.
McCarthy, Margaret Theresa,	4,	Phillipsburg, N. J.
McCaulley, Selinda,	11, 13,	Philadelphia.
McCormick, Mildred H.,	6,	Harrisburg.
McClary, Grace Lucy,	4,	Phillipsburg, N. J.
McCullough, Harry A., B.S.,	6, 14,	Allentown.
McGowan, Alice C.,	6,	Harrisburg.
McHale, Anna Colette,	4,	Phillipsburg, N. J.
McHenry, Sara M.,	12,	Philadelphia.
McNally, John H.,	8,	Bethlehem.
McLaughlin, Catherine Tyne,	4,	Phillipsburg, N. J.
Mack, Henry J.,	8,	Bethlehem.
Maloney, Michael Edward,	4,	Phillipsburg, N. J.
Mann, Mrs. Edna F.,	6,	Harrisburg.
Markle, Ella Evelyn,	4,	Easton.
Marstellar, Howard T.,	11,	Somers Point, N. J.
Maurer, Mabel,	6,	Harrisburg.
Maury, Emma Elizabeth,	6,	Allentown.
Meckley, Mabel Lorene,	6,	Harrisburg.
Melville, Claudine,	6,	Harrisburg.
Mengel, Priscilla D.,	11,	Philadelphia.
Mengel, C. E.,	8,	Bethlehem.
Metzger, Elizabeth,	10,	Bethlehem.
Metz, Florence Estella,	4,	Pittsburgh.
Meyers, Samuel,	8,	Bethlehem.
Mickey, Mary,	6,	Harrisburg.
Midlam, Anna M.,	6,	Harrisburg.
Mill, Ella,	8,	Easton.
Miller, Elmer F.,	14,	Orefield.
Miller, Gertrude R.,	6,	Harrisburg.
Miller, Lillie M.,	6,	Harrisburg.
Minnig, Blanche LaVergne,	6,	Harrisburg.
Minton, Louise,	4,	Washington, N. J.
Mitchell, Helen C.,	8,	Phillipsburg, N. J.
Mitchell, Minnie C.,	8,	Phillipsburg, N. J.
Mood, Edwin Nunamaker,	4,	Phillipsburg, N. J.

Moos, Stella Wolf,	11,	Jenkintown.
Moyer, Anna C.,	8,	Phillipsburg, N. J.
Mueller, Margaret,	10,	Watertown, Wis.
Munroe, Henry C., M.D.,	11,	Pleasantville, N. J.
Murray, Marion H.,	6, 11,	Bethlehem.
Myers, Margaret,	6,	Harrisburg.
Myers, Carrie Estella,	6,	Harrisburg.
Myers, Elizabeth Adeline,	4,	Phillipsburg, N. J.
Nice, Ruth A.,	10,	Upper Black Eddy.
Nicholas, Elizabeth M.,	13,	Easton.
Nie, Alice Esther,	4,	Phillipsburg, N. J.
Nixon, Elsie M.,	6,	Harrisburg.
Nixon, Helen B.,	6, 14,	Harrisburg.
Nixon, W. Sargent,	8,	Phillipsburg, N. J.
O'Connell, Mary,	6,	Harrisburg.
Olanoff, Rose,	11,	Philadelphia.
Ort, Florence,	6,	Harrisburg.
Orth, Carrie, Louise,	6,	Harrisburg.
Orth, Rebecca,	6,	Harrisburg.
Paist, Anna Windle,	11, 12,	Philadelphia.
Parrish, Charlotte B.,	8,	Phillipsburg, N. J.
Patterson, Caroline,	6,	Harrisburg.
Pearson, Elizabeth A.,	8,	Easton.
Pedley, Florella F., A.B.,	11,	Philadelphia.
Pendergast, Gertrude Elizabeth,	6,	Harrisburg.
Pfeiffer, Marie Elizabeth.	4,	Phillipsburg, N. J.
Pierson, Nattie E.,	4,	Phillipsburg, N. J.
Pohl, Elizabeth Shimer,	8, 13,	Easton.
Pursell, Mrs. Ada Sliker,	4,	Phillipsburg, N. J.
Quinn, Lucy,	12,	Atlantic City, N. J.
Radford, G. Reginald,	8,	Bethlehem.
Rausch, Katherine Alice,	6,	Allentown.
Rausch, Caroline Thomas,	6,	Progress.
Ray, James R.,	8,	Bethlehem.
Reeder, Howard D.,	8,	Bethlehem.
Reen, Sarah Kerner,	6,	Harrisburg.
Renninger, John Daub, A.B.,	6, 14,	Harrisburg.
Reaser, Mrs. Sarah Ella Madden,	4,	Phillipsburg, N. J.
Richards, W. F.,	11,	Pleasantville, N. J.
Richwine, George H.,	6,	Harrisburg.

Reilley, Josephine C.,	8,	Phillipsburg, N. J.
Rhoades, Eleanor,	11,	Philadelphia.
Rishel, Dorothy M.,	6,	Harrisburg.
Roarty, Margaret Anne,	6,	Allentown.
Robeson, Vida A.	4,	Phillipsburg, N. J.
Robinson, Edward Moore, E.M.,	8,	Bethlehem.
Romig, Helen Elizabeth,	1,	Philadelphia.
Rose, Edward Gardner,	6,	New Cumberland.
Ross, Florine,	11,	Camden, N. J.
Roth, Lillie Hannah,	6,	Allentown.
Ruch, Asker J.,	8,	Bethlehem.
Ruef, Rorothy Northrup,	4,	Phillipsburg, N. J.
Rundle, Jessie M.,	13,	Easton.
Sanford, A.,	4,	Washington, N. J.
Schaeffer, Anna,	4,	Phillipsburg, N. J.
Schaible, Cora,	11,	Absecon, N. J.
Scheirer, Esther M.,	6,	Allentown.
Schick, Floyd E.,	8,	Bethlehem.
Schlaepfer, Robert G.,	8,	Bethlehem.
Schlayer, Anna C.,	6,	Harrisburg,
Schott, Frank W.,	8,	Bethlehem.
Schwaninger, Mary Alice, A.B.,	18,	Allentown.
Scott, Rachel M.,	13,	Easton.
Scott, Rosa Elizabeth,	13,	Easton.
Search, Hendrick Monroe, C.E.,	8,	Bethlehem.
Seiberling, Anna C.,	11,	Atlantic City, N. J.
Shane, Mary E.,	6,	Harrisburg.
Sherk, Esther,	6,	Harrisburg.
Shilling, Margaret E.,	6,	Harrisburg.
Shimer, Robert Hoffman, M.E.,	8,	Bethlehem.
Shoemaker, Rebecca Jane,	6,	Harrisburg.
Short, Ida K.,	6,	Harrisburg.
Showell, Townsend D.,	11,	Philadelphia.
Shradley, Mildred,	6,	Harrisburg.
Shunk, Helen,	1,	Bethlehem.
Simons, Helen Britten,	11,	Philadelphia.
Slosson, Mrs. Helen M.,	4, 8, 11, 17,	Easton.
Smith, Hilda R.,	11,	Petersburgh, N. J.
Smith, Martha S.,	8,	Easton.
Snyder, Vera,	8,	Easton.

Somers, Mary C.,	11,	Atlantic City, N. J.
Sotzing, Ralph W.,	8,	Bethlehem.
Sourbeer, Dora Calder,	6,	Harrisburg.
Spangler, Nora M.,	6,	Harrisburg.
Spatz, Eva Margaret,	6,	Allentown.
Starr, C. T.,	8,	Bethlehem.
Stambaugh, Elda G.,	6,	Harrisburg.
Steelman, Henrietta,	11,	Pleasantville, N. J.
Stemler, Hettyer Esther,	6,	Harrisburg.
Stephenson, Ida M.,	11,	Pleasantville, N. J.
Stover, Bertha L.,	11,	Philadelphia.
Strohmeier, Adella E.,	6,	Easton.
Stryker, Nellie Esther,	4,	Phillipsburg, N. J.
Strauss, Jesse C.,	8,	Allentown.
Sullivan, W. C.,	11,	Pleasantville, N. J.
Tack, Sara A.,	6,	Harrisburg.
Tatnal, Edna Grace,	6, 14,	Harrisburg.
Telfer, Vera May,	4,	Belvidere, N. J.
Templeton, Kenneth Rodie,	8,	Easton.
Thierolf, Walter Raymond,	4,	Easton.
Thomas, George E.,	14,	Allentown.
Thomas, Maria C.,	11,	Pleasantville, N. J.
Thomas, Martin H.,	6,	Harrisburg.
Thomas, Mary Book,	6,	Harrisburg.
Thomas, Ralph,	4,	Phillipsburg, N. J.
Tinker, William M., M.A.,	14,	Allentown.
Tittle, A. May,	6,	Harrisburg.
Tittle, Elizabeth,	6,	Harrisburg.
Tressler, Samuel Martin,	4,	Washington, N. J.
Trimmer, John William,	4,	Phillipsburg, N. J.
Tritt, Elizabeth,	6,	Harrisburg.
Turner, Mary Eleanor,	6,	Bethlehem.
Updegraff, Sadie,	11,	Atlantic City, N. J.
Valentine, Mary B.,	11,	Westville, N. J.
Van Gilder, Sara S.,	11,	Petersburgh, N. J.
Vance, J. Gertrude,	11,	Atlantic City, N. J.
Vaughn, Mabel E.,	6,	Harrisburg.
Vernet, Natalie,	8,	Easton.
Viana, Mary M.,	11,	Atlantic City, N. J.
Villee, Sallie H.,	13,	Bethlehem.

Volkhardt, Charles Edward,	8,	Bethlehem.
Vollmer, Emma,	6,	Harrisburg.
Wall, Martha E.,	6,	Harrisburg.
Wallick, Mrs. Louella Christine,	6,	Bethlehem.
Wallick, Ray G.,	6, 7,	Bethlehem.
Walker, Elizabeth Ruth.	4,	Phillipsburg, N. J.
Wals, Bridgie,	4,	Phillipsburg, N. J.
Walsh, Cecelia,	4,	Phillipsburg, N. J.
Walter, Helen,	1,	Bethlehem.
Walter, Leonia Madeline,	4,	Phillipsburg, N. J.
Walters, Edith Matilda,	4,	Phillipsburg, N. J.
Walzer, Anna M.,	6,	Harrisburg.
Walzer, Ruth M.,	6,	Harrisburg.
Wantzel, Dorothy Louise,	1,	Egg Harbor City, N. J.
Warlow, Mary,	6,	Harrisburg.
Weber, Dorothy Hill,	10,	York.
Weeks, Elsie,	11,	Atlantic City, N. J.
Weirbach, T. Mahlon, B.S.,	6, 14,	Allentown.
Weirick, Iva C.,	6,	Harrisburg.
Wellman, Henry G., M.A.,	11,	Atlantic City, N. J.
Welte, Jane M.,	11,	Philadelphia.
Wentz, Homer Henry,	14,	Allentown.
Wetherhold, Ralph V.,	6,	Allentown.
Wetherstine, Katherine M.,	11,	Philadelphia.
White, Mrs. Amanda S.,	12,	Philadelphia.
Whittaker, Alice E.,	11,	Margate City, N. J.
Wilbur, Robert Eldredge,	8,	Bethlehem.
Willey, Mary Francis,	11,	Atlantic City, N. J.
Williams, Charlotte Elizabeth,	8,	Phillipsburg, N. J.
Williams, Chester Hoagland,	4,	Phillipsburg, N. J.
Williams, Helen G.,	11,	Atlantic City, N. J.
Williams, James Henry,	6,	Harrisburg.
Williamson, Charles H.,	4,	Phillipsburg, N. J.
Wilson, Charles Oscar,	11,	Pleasantville, N. J.
Wood, Sarah Elizabeth,	6,	Harrisburg.
Woodward, Harriet N.,	8,	Phillipsburg, N. J.
Wright, Mrs. Ada V.,	6,	Allentown.
Wuchter, Miriam H.,	1,	Allentown.

Vuchter, Miriam Henrietta,	1,	Allentown.
Vyckoff, Herbert J., A.B.,	11,	Bryn Mawr.
Yeager, Howard James,	6, 7,	Emaus.
Yetter, Mary F. A.,	8,	Phillipsburg, N. J.
Ziegenfuss, Warren A.,	6, 14,	Allentown.
Zimmerman, Annie Minerva,	6,	Harrisburg.
Zimmerman, Edward W.,	6,	Allentown.

SUMMARY OF STUDENTS BY CLASSES AND COURSES

	* Graduates	Seniors	Juniors	Sophomores	Freshmen	Specials	Totals
Arts & Science	36	12	5	33	48	5	139
Business.....	1	9	16	53	79	8	166
Civil Eng.....	2	24	26	44	35	3	134
Mech. Eng.....		24	25	42	67		158
Mining Eng....	3	17	21	25	30	2	98
Metal. Eng.....	12	7	17	15	24		75
Electromet.....		9					9
Electric. Eng...	6	12	14	53	47		132
Chemistry.....	8	1			2	1	12
Chem. Eng.....	2	27	39	32	47	2	149
Naval Eng.....			12	5	14	1	32
Totals	70	142	175	302	393	22	1104

*Graduate students are listed in the department in which they are taking their major subject.

Students in Evening Courses in Naval Architecture.....	34
Students in Evening School of Business Administration..	62
Students in Extension Summer Session, 1920.....	30
Students in Extension Courses, First Term, 1920-21.....	432
Total	558

GEOGRAPHICAL SUMMARY OF STUDENTS

Alabama	1
California	3
Colorado	1
Connecticut	18
Delaware	5
District of Columbia	45
Florida	3
Georgia	2
Illinois	6
Indiana	2
Iowa	1
Kentucky	1
Maryland	40
Massachusetts	15
Michigan	5
Minnesota	1
Missouri	1
New Hampshire	1
New Jersey	158
New York	85
North Carolina	5
Ohio	19
Oklahoma	1
Pennsylvania	612
Rhode Island	5
South Carolina	2
Tennessee	3
Texas	2
Utah	1
Vermont	1
Virginia	9
West Virginia	9
Wisconsin	3
Argentine Republic	2
Brazil	1
Chile	2
China	15

Colombia	3
Cuba	1
England	1
Greece	2
Hawaii	1
Italy	1
Japan	1
Java	1
Mexico	2
Panama	1
Russia	1
Siam	1
Spain	1
Venezuela	1
	1104

INDEX

Administrative Officers, 15.
Admission of Students, 17, 30.
  Requirements, 17-19.
Advanced Standing, Admission to, 28.
Almanac, 2.
Alumni Association, 172.
Alumni Prizes, 173.
  Award in 1920, 164.
Alumni Prizes for Oratory, 174.
Arboretum, 161.
Arts and Science Club, 163.
Arts and Science, College of
  Description, 31.
  Requirements for admission, 17.
  Schedules of studies, 33-37.
  Undergraduate courses, 76.
Assistant Professors, 9.
Associate Professors, 8.
Astronomy
  Graduate courses, 136.
  Observatory, 153.
  Undergraduate courses, 90.
Athletic Field, 160.
Biology
  Graduate courses, 142.
  Undergraduate courses, 106.
Buildings, 148.
Business Administration, College of
  Description, 39.
  Requirements for admission, 18.
  Schedule of studies, 41.
  Undergraduate courses, 77.
Calendar, 3.
Callender Fellowship, 171.
Carson Prize, 172.
  Award in 1920, 164.
Certificates, 30.
Chemical and Metallurgical Laboratories, 148.
Chemical Engineering, Course in
  Description, 67.
  Requirements for admission, 19.
  Schedule of studies, 71.
Chemistry, Course in
  Description, 64.
  Graduate courses, 144.
  Requirements for admission, 19.
  Schedule of studies, 66.
  Undergraduate courses, 117.
Christmas Hall, 156.
Civil Engineering, Course in
  Description, 42.
  Graduate courses, 145.
  Requirements for admission, 19.
  Schedule of studies, 45.
  Undergraduate courses, 91.
College Commons, 159.
Committee on Admission, 15.
Conference Department, 14, 125.
Coppee Hall, 157.
Coxe Memorial Fund, 171.
Coxe Memorial Library, 154.
Coxe Mining Laboratory, 155.
Departmental Societies, 162.
Dormitories, 158.
Drown Memorial Hall, 158.
Du Pont Fellowship, 171.
Economics
  Graduate courses, 137.
  Undergraduate courses, 77.
Economic Geography, 80.
Education
  Graduate courses, 142.
  Undergraduate courses, 75.
Electrical Engineering, Course in
  Description, 59.
  Graduate courses, 138.
  Requirements for admission, 19.
  Schedule of studies, 63.
  Undergraduate courses, 112.
Engineering Societies, 162.
English
  Graduate courses, 137.
  Undergraduate courses, 88.
Examination, Entrance, 28.
  Examinations at schools, 30.
Expenses, 146.
Extension Courses, 125.
Faculty, 6.
Forestry, 106.
Founder's Day, 163.
Frazier and Ringer Memorial Fund, 177.
Fritz Engineering Laboratory, 154.
French
  Graduate courses, 143.
  Undergraduate courses, 86.
Geology
  Graduate courses, 141.
  Undergraduate courses, 102.
German
  Graduate courses, 140.
  Undergraduate courses, 85.
Graduate Courses
  Admission to, 30, 135.
  List, 133.
Greek,
  Graduate courses, 138.
  Undergraduate courses, 83.
Gymnasium
  Description, 159.
  Physical education, 124.
Haines Scholarship, 170.
History
  Graduate courses, 137.
  Undergraduate courses, 81.
Honor List, 1920, 164.
Honor System, 163.
Honorary Scholarship Societies, 162.
Instructors, 12.
Italian, 88.

Latin.
Graduate courses, 138.
Undergraduate courses, 81.
Lectures, 162.
Lecturers, 9.
Library
University Library, 158.
Officers of, 15.
Coxe Memorial Library, 158.
List of Studies
Graduate courses, 135.
Undergraduate courses, 75.
Mathematics
Graduate courses, 136.
Undergraduate courses, 90.
Mechanical Engineering, Course in
Description, 46.
Requirements for admission, 19.
Schedule of studies, 49.
Undergraduate courses, 95.
Mercur, Scholarships, 170.
Metallurgical Engineering, Course in
Description, 50.
Graduate courses, 139.
Requirements for admission, 19.
Schedule of studies, 53.
Undergraduate courses, 99.
Military Science and Tactics, 122.
Mining Engineering, Course in
Description, 54.
Graduate courses, 140.
Requirements for admission, 19.
Schedule of studies, 58.
Undergraduate courses, 108.
Museums, 161.
Observatory, 157.
Packer Hall, 148.
Packer Memorial Church, 15.
Description, 158.
Services, 163.
Philosophy
Graduate Courses, 142.
Undergraduate courses, 75.
Physical Education, 124.
Physical Laboratory, 149.
Physics
Graduate courses, 144.
Undergraduate courses, 110.
Political Science, 80.
Portuguese, 87.
Pre-Medical Courses, 35.
Price Hall, 159.
Price Prize, 172.
Prickitt Scholarship, 170.
Prizes
Alumni Prizes, 173.
Carson Prize, 172.
Price Prize, 172.
Wilbur Prizes, 172.
Williams Prizes, 175.
Professors, 6.
Psychology
Graduate courses, 142.
Undergraduate courses, 75.
Romance Languages, 86.
Saucon Hall, 156.
Sayre Observatory, 157.
Sayre Park, 160.
Scholarships
Coxe Memorial Fund, 171.
Du Pont Scholarship, 171.
Haines Scholarship, 170.
Mercur Scholarship, 170.
Prickitt Scholarship, 170.
Wilbur Scholarship, 170.
Williams Fund, 171.
Ship Construction and Marine Transportation, Course in
Description, 72.
Requirements for admission, 19.
Schedule of studies, 74.
Undergraduate courses, 121.
Site of the University, 147.
Spanish, 87.
Students, List of, for 1920-1921, 178.
Graduate Students, 178.
Seniors, 182.
Juniors, 185.
Sophomores, 190.
Freshmen, 197.
Special Students, 207.
Extension Course Students, 211.
Summary of Students:
By Classes and Courses, 223.
By Geographical representation, 224.
Studies, List of, 75.
Summer Term, 134.
Taylor Field, 160.
Taylor Gymnasium, 159.
Taylor Hall, 158.
Teachers' Courses, 37, 125.
Theses, 163.
Trustees, 4.
Committees, 5.
Honorary Alumni Trustees, 4.
Officers of the Board, 5.
Tuition, 146.
Undergraduate Courses, 75.
University Day, 164.
University Sunday. 163.
Wilbur Engineering Laboratory, 151.
Wilbur Prizes, 172.
Award in 1920, 164.
Wilbur Scholarship, 170.
Award in 1920, 164.
Williams Fund, 171.
Williams Hall, 153.
Williams Prizes, 175.
Y. M. C. A., 163.

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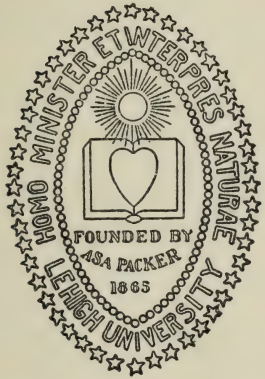

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JANUARY

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JUNE

S	M	T	W	T	F	S
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JULY

S	M	T	W	T	F	S
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AUGUST

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SEPTEMBER

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OCTOBER

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NOVEMBER

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DECEMBER

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1923

JANUARY

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FEBRUARY

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MARCH

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APRIL

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MAY

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JUNE

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CALENDAR

1921	1921—1922
Sept. 16, 17, 19, 20, (Friday, Saturday, Monday, Tuesday)	Examinations for admission.
Sept. 21, 3.30 P.M., (Wednesday) . . .	First term begins.
Oct. 1, (Saturday)	Founder's Day.
Nov. 24, (Thursday)	Thanksgiving holiday.
Dec. 17, 12.00 M., (Saturday)	Christmas holidays begin.
1922	
Jan. 2, 7.45 A.M., (Monday)	Christmas holidays end.
Jan. 27, 8.00 A.M., (Friday)	Examinations begin.
Feb. 3, 5.00 P.M., (Friday)	Examinations end.
Feb. 6, 7.45 A.M., (Monday)	Second term begins.
Feb. 22, (Wednesday, Washington's Birthday)	Junior Oratorical Contest.
April 22, 12.00 M., (Saturday)	Spring vacation begins.
May 1, 7.45 A.M., (Monday)	Spring vacation ends.
May 29, 8.00 A.M., (Monday)	Senior examinations begin.
May 31, 8.00 A.M., (Wednesday) . . .	Other examinations begin.
June 7, 5.00 P.M., (Wednesday)	Examinations end.
June 10, (Saturday)	Alumni Day.
June 11, (Sunday)	Baccalaureate Sunday.
June 12, (Monday)	Class Day.
June 13, (Tuesday)	University Day.
June 14, (Wednesday)	Summer term begins.
June 14, 15, 16, 17, (Wednesday, Thursday, Friday, Saturday)	Examinations for admission.

1922	1922—1923
Sept. 15, 16, 18, 19, (Friday, Saturday, Monday, Tuesday)	Examinations for admission.
Sept. 20, 3.30 P.M., (Wednesday) . . .	First term begins.
Oct. 7, (Saturday)	Founder's Day.
Nov. 30, (Thursday)	Thanksgiving holiday.
Dec. 20, 5.00 P.M., (Wednesday) . . .	Christmas holidays begin.
1923	
Jan. 4, 7.45 A.M., (Thursday)	Christmas holidays end.
Jan. 26, 8.00 A.M., (Friday)	Examinations begin.
Feb. 2, 5.00 P.M., (Friday)	Examinations end.
Feb. 5, 7.45 A.M., (Monday)	Second term begins.
Feb. 22, (Thursday, Washington's Birthday)	Junior Oratorical Contest.
April 28, 12.00 M., (Saturday)	Spring vacation begins.
May 7, 7.45 A.M., (Monday)	Spring vacation ends.
May 28, 8.00 A.M., (Monday)	Senior examinations begin.
May 30, 8.00 A.M., (Wednesday) . . .	Other examinations begin.
June 6, 5.00 P.M., (Wednesday)	Examinations end.
June 9, (Saturday)	Alumni Day.
June 10, (Sunday)	Baccalaureate Sunday.
June 11, (Monday)	Class Day.
June 12, (Tuesday)	University Day.
June 13, (Wednesday)	Summer term begins.
June 13, 14, 15, 16, (Wednesday, Thursday, Friday, Saturday)	Examinations for admission.

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† In executive charge from January 1, 1921.
** Died October 12, 1921.

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Lehigh University was chartered by the Legislature of Pennsylvania by act dated February 9, 1866. In 1865 the Hon. Asa Packer, of Mauch Chunk, inaugurated a movement to provide an institution that would afford training and education in the learned professions as then recognized, and in technical branches, the importance of which was then just becoming apparent in the development of the industrial and transportation interests of the country. He made an initial donation of $500,000 and of a large tract of land for this purpose, to which he added largely during his lifetime and by his will.

Since its foundation the equipment and resources of the University have steadily increased due to the continued interest of the University's trustees, alumni and friends. The present endowment totals $3,000,000. The first important addition to the University's original plant was the Sayre Observatory, donated in 1869 by Robert H. Sayre, of Bethlehem. Later donations include Packer Memorial Church, 1887; Williams Hall, 1902; Drown Memorial Hall, 1907; the University Commons, 1907; the Wilbur Heating Plant and Engineering Laboratory, 1907; Taylor Hall, 1907; Sayre Park, 1909; Coxe Mining Laboratory, 1910; Fritz Engineering Laboratory, 1910; Taylor Gymnasium and Taylor Field, 1913.

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COLLEGE OF BUSINESS ADMINISTRATION:

1. The Course in Business Administration.

COLLEGE OF ENGINEERING:

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2. The Course in Mechanical Engineering.
3. The Course in Metallurgy.
4. The Course in Mining Engineering.
5. The Course in Electrical Engineering.
6. The Course in Chemistry.
7. The Course in Chemical Engineering.
8. The Course in Ship Construction and Marine Transportation.

Courses are described in detail on pages 32 to 75.

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Candidates for admission to Lehigh University must be at least sixteen years of age, must present testimonials of good moral character, and must be qualified in the entrance subjects as enumerated below.

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(a) Candidates for admission must present entrance requirements as follows:*

	Units
English,	3
History,	1
Elementary Algebra, A and B,	1½
Plane Geometry,	1
Latin A and B or German A or French A or Spanish A,	2
	8½

(b) Candidates must present besides the subjects in (a), 6½ units from the following:

	Units
Advanced Algebra,	½
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
Greek,	2 or 3
Latin,	2, 3 or 4
French,	1, 2 or 3
German,	1, 2 or 3
Spanish,	1, 2 or 3
American History,	1
Ancient History,	1
Modern History,	1
English History,	1
Physics,	1
Chemistry,	1
Zoölogy,	½ or 1
Botany,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Unassigned,	½ or 1

Detailed information concerning these subjects is given on pages 21 to 28.

* A unit represents a year's study in any subject in a secondary school, constituting approximately a quarter of a full year's work. A four-year secondary school curriculum should be regarded as representing not more than sixteen units of work.

THE COLLEGE OF BUSINESS ADMINISTRATION

(a) Candidates must present the following subjects:

	Units
English,	3
History,	1
Elementary Algebra, A and B,	1½
Plane Geometry,	1
German A or French A or Spanish A or Latin A and B,	2
	8½

(b) Candidates must present besides the subjects in (a), 5½ units from the following:

	Units
Advanced Algebra,	½
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
Latin,	2, 3 or 4
French A or German A or Spanish A,	2
American History,	1
Ancient History,	1
Modern History,	1
English History,	1
Freehand Drawing,	½
Mechanical Drawing,	½
Physics,	1
Elementary Chemistry,	1
Zoölogy,	½ or 1
Botany,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Manual Training,	½ or 1
Bookkeeping, Stenography, Typewriting,	1 or 2
Industrial History,	1
Civics,	1
Economics,	1
Sociology,	1
Commercial Geography,	1

Detailed information concerning these subjects is given on pages 21 to 28.

THE COLLEGE OF ENGINEERING

(a) Candidates for admission to the Courses in Civil Engineering, Mechanical Engineering, Metallurgical Engineering, Mining Engineering, Electrical Engineering, Chemistry, Chemical Engineering, and Ship Construction and Marine Transportation must present the following subjects:

	Units
English,	3
History,	1
Elementary Algebra, A and B,	1½
Plane Geometry,	1
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
German A or French A or Spanish A,	2
	9½

(b) Candidates must present besides the subjects in (a), 4½ units from the following:

	Units
Advanced Algebra,	½
Latin,	2, 3 or 4
Greek,	2 or 3
German,	2 or 3
French,	2 or 3
Spanish,	2 or 3
American History,	1
Ancient History,	1
Modern History,	1
English History,	1
Freehand Drawing,	½
Mechanical Drawing,	½
Physics,	1
Elementary Chemistry,	1
Zoölogy,	½ or 1
Botany,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Manual Training,	½ or 1

Detailed information concerning these subjects is given on pages 21 to 28.

The detailed requirements in the various subjects are as follows:

ENGLISH

Preparation in English has three main objects: (a) command of correct and clear English, spoken and written; (b) ability to use the vernacular with accuracy and appreciation; and (c) some acquaintance with the simpler English classics.

ENGLISH GRAMMAR AND COMPOSITION. The first two objects require instruction in grammar and composition. English grammar should be reviewed in the secondary school; and correct spelling and grammatical accuracy should be rigorously exacted in connection with all written work during the four years. The principles of English composition governing punctuation, the use of words, paragraphs, and the different kinds of composition, including letter writing, should be thoroughly mastered; and practice in composition, oral as well as written, should extend throughout the secondary school period. Written exercises may well comprise narration, description, and easy exposition based upon the principles of elementary rhetoric, as given in any approved high school rhetoric. It is advisable that subjects for this work be taken from the student's personal experience, general knowledge, and studies other than English, as well as from his reading in literature. Finally, special instruction in language and composition should be supported by concerted efforts of teachers in all branches to cultivate in the student the habit of using good English in his recitations and various exercises, whether oral or written, making every recitation in some degree an exercise in English.

LITERATURE. The third object is sought by means of two lists of books, headed respectively reading and study; from which may be framed a progressive course in literature covering four years. In connection with both lists, the student should be trained in reading aloud and be encouraged to commit to memory some of the more notable passages both in verse and in prose. The books for reading and study are to be selected from the groups suggested by the Conference on Uniform Entrance Requirements in English. 3 units.

HISTORY

The requirement in History is based on the recommendation of the Committee of Seven of the American Historical Association.

Ancient History, with special reference to Greek and Roman History, and including also a short introductory study of the more ancient nations and the chief events of the early Middle Ages, down to the death of Charlemagne (814). 1 unit.

Mediaeval and Modern European History, from the death of Charlemagne to the present time. 1 unit.

English History, with due reference to social and political development. 1 unit.

American History and Civil Government, with due reference to social and political development. 1 unit.

The examinations in history will be so framed as to require comparison and the use of judgment on the pupil's part rather than the mere use of memory. The examinations will presuppose the use of good text-books, collateral reading, and practice in written work. Geographical knowledge will be tested by requiring the location of places and movements on an outline map.

MATHEMATICS

Elementary Algebra, A (Algebra to Quadratics). The four fundamental operations for rational algebraic expressions. Factoring, determination of highest common factor and lowest common multiple by factoring. Fractions, including complex fractions, and ratio and proportion. Linear equations, both numerical and literal, containing one or more unknown quantities. Problems depending on linear equations. Radicals, including the extraction of the square root of polynomials and of numbers. Exponents, including the fractional and negative. 1 unit.

Elementary Algebra, B (Quadratics and Beyond). Quadratic equations, both numerical and literal. Simple cases of equations with one or more unknown quantities, that can be solved by the methods of linear or quadratic equations. Problems depending on quadratic equations. The binomial theorem for positive integral exponents. The formulas for the nth term and the sum of the terms of arithmetic and geometric progressions with applications. ½ unit.

ADVANCED ALGEBRA. Permutations and combinations, limited to simple cases. Complex numbers, with graphical representation of sums and differences. Determinants, chiefly of the second, third, and fourth orders, including the use of minors and the solution of linear equations. Numerical equations of higher degree, and so much of the theory of equations, with graphical methods, as is necessary for their treatment, including Descarte's rule of sign and Horner's method, but not Sturm's functions or multiple roots. ½ unit.

PLANE GEOMETRY. The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas; regular polygons and the measurements of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of line and plane surfaces. 1 unit.

SOLID GEOMETRY. The usual theorems and constructions of good text-books, including the relations of planes and lines in space; the properties and measurements of prisms, pyramids, cylinders and cones; the sphere and the spherical triangle. The solution of numerous original exercises, including loci problems. Application to the mensuration of surfaces and solids. ½ unit.

PLANE TRIGONOMETRY. Definitions and relations of the six trigonometric functions as ratios; circular measurement of angles. Proofs of principal formulas, in particular for the sine, cosine, and tangent of the sum and the difference of two angles, of the double angle and the half angle, the product expressions for the sum or the difference of two sines or of two cosines, etc.; the transformation of trigonometric expressions by means of these formulas. Solution of trigonometric equations of a simple character. Theory and use of logarithms (without the introduction of work involving infinite series). The solution of right and oblique triangles and practical applications. Candidates must bring their logarithmic tables to the examination. ½ unit.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of the metric system.

PHYSICS

The course of instruction in Physics should include:

(a) The study of some standard text-book, for the purpose of obtaining a connected view of the subject; (b) instruction by lecture table demonstrations, to be used mainly for illustration of the facts and phenomena of physics; (c) individual laboratory work consisting of at least thirty experiments.

The aim of laboratory work should be to supplement the pupil's fund of concrete knowledge and to cultivate his power of accurate observation and clearness of thought and expression. The exercises should be chosen with a view to furnishing forceful illustrations of fundamental principles and their practical applications. They should be such as to yield results capable of ready interpretation, obviously in conformity with theory, and free from the disguise of unintelligible units.

1 unit.

GERMAN

Elementary German, A. This requirement follows, in the main, the recommendation of the Committee of Twelve of the Modern Language Association. It is expected that two whole years will be given to the work.

During the first year the work should comprise: (1) Careful drill in pronunciation. (2) The memorizing and frequent repetition of easy colloquial sentences. (3) Drill upon the rudiments of grammar, that is, upon the inflection of the articles, of such nouns as belong to the language of every-day life, of adjectives, pronouns, weak verbs and the more usual strong verbs; also upon the use of the more common prepositions, the simpler uses of the modal auxiliaries and the elementary rules of syntax and word-order. (4) Abundant easy exercises, designed not only to fix in mind the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression. (5) Reading of from 75 to 100 pages of graduated texts from a reader, with constant practice in translating into German easy variations upon sentences selected from the reading lesson (the teacher giving the English), and in the reproduction from memory of sentences previously read.

During the second year the work should comprise: (1) The reading of from 150 to 200 pages of literature in the form of

easy stories and plays. (2) Accompanying practice, as before, in the translation into German of easy variations upon the matter read and in the off-hand reproduction, sometimes orally and sometimes in writing, of the substance of short and easy selected passages. (3) Continued drill in the rudiments of the grammar, directed to the ends of enabling the pupil, first, to use his knowledge with facility in the formation of sentences, and secondly, to state his knowledge correctly in the technical language of grammar. 2 units.

INTERMEDIATE GERMAN, B. This work should comprise, in addition to the elementary course, the reading of about 400 pages of moderately difficult prose and poetry, with constant practice in giving, sometimes orally and sometimes in writing, paraphrases, abstracts, or reproductions from memory of selected portions of the matter read; also grammatical drill upon the less usual strong verbs, the use of articles, cases, auxiliaries of all kinds, tenses and modes (with special reference to the infinitive and the subjunctive), and likewise upon word order and word formation. 1 unit.

FRENCH

ELEMENTARY FRENCH, A. This requirement follows, in the main, the recommendation of the Committee of Twelve of the Modern Language Association. It is expected that two whole years will be given to the work.

During the first year the work should comprise: (1) Careful drill in pronunciation. (2) The rudiments of grammar, including the inflection of the regular and the more common irregular verbs, the plural of nouns, the inflection of adjectives, participles and pronouns; the use of personal pronouns, common adverbs, prepositions and conjunctions; the order of words in the sentence and the elementary rules of syntax. (3) Abundant easy exercises, designed not only to fix in the memory the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression. (4) The reading of from 100 to 175 pages of graduated texts, with constant practice in translating into French easy variations of the sentences read (the teacher giving the English), and in reproducing from memory sentences previously read. (5) Writing French from dictation.

During the second year the work should comprise: (1) The reading of from 250 to 400 pages of easy modern prose in the form of stories, plays or historical or biographical sketches. (2) Constant practice, as in the previous year, in translating into French easy variations upon the texts read. (3) Frequent abstracts, sometimes oral and sometimes written, of portions of the text already read. (4) Writing French from dictation. (5) Continued drill upon the rudiments of grammar, with constant application in the construction of sentences. (6) Mastery of the forms and uses of pronouns, pronominal adjectives, of all but the rare irregular verb forms, and of the simpler uses of the conditional and subjunctive. 2 units.

INTERMEDIATE FRENCH, B. This should comprise the reading of from 400 to 600 pages of French of ordinary difficulty, a portion to be in the dramatic form; constant practice in giving French paraphrases, abstracts or reproductions from memory of selected portions of the matter read; the study of a grammar of moderate completeness; writing from dictation. 1 unit.

SPANISH

ELEMENTARY SPANISH, A. Two years' preparation, covering the following ground:

During the first year: (1) Drill in correct production of Spanish sounds. (2) The rudiments of grammar, illustrated by abundant easy exercises. (3) The reading of about 150 pages of graduated texts with constant translating into Spanish of easy variations of sentences read, the teacher giving the English. (4) Aural Drill. Practice in translating into English of Spanish words, clauses and sentences heard but not seen, the teacher giving the Spanish.

During the second year: (1) Reading of 250 to 400 pages of easy modern prose. (2) Constant practice in translating into Spanish easy variations upon the texts read. (3) Aural practice and drill in pronunciation. (4) Mastery of the form and uses of pronouns, of the subjunctive mode and of the forms of the radical changing verbs. 2 units.

INTERMEDIATE SPANISH, B. The reading of not less than 500 additional pages of Spanish prose together with the translation of at least 40 pages of simple connected English prose into Spanish. 1 unit.

LATIN

The following requirements in Latin are in accordance with the recommendation made by the American Philological Association, October, 1909.

LATIN, A and B. First and Second Year Latin. Grammar, Elementary Prose Composition. Reading of an amount not less than Cæsar, *Gallic War*, I-IV, selected by the schools from Cæsar (*Gallic War* and *Civil War*) and Nepos (*Lives*). 2 units.

LATIN, C. Third Year Latin. Reading of an amount not less than Cicero, *Orations against Catiline*, *For the Manilian Law*, and *For Archias*, selected by the schools from Cicero (*Orations*, *Letters* and *De Senectute*) and Sallust (*Catiline* and *Jugurthine War*). 1 unit.

LATIN, D. Fourth Year Latin. Reading of an amount not less than Vergil, *Aeneid*, I-VI, selected by the schools from Vergil (*Aeneid*, *Bucolics*, and *Georgics*) and Ovid (*Metamorphoses*, *Fasti*, *Tristia*, *Amores*). 1 unit.

GREEK

GREEK. Grammar; Elementary Prose Composition, consisting principally of detached sentences to test the candidate's knowledge of grammatical construction; Xenophon: the first four books of the *Anabasis;* the translation, at sight, of a passage from some work of Xenophon. 2 units.

GREEK. Homer's *Iliad*, I-III: The first three books of the *Iliad* (omitting II, 494-end), and the Homeric forms, constructions, and prosody. 1 unit.

CHEMISTRY

The requirement in Chemistry is based on the report of the Committee on Chemistry of the Science Department of the National Educational Association.

ELEMENTARY CHEMISTRY. It is recommended that the candidate's preparation in chemistry include: (a) individual laboratory work, comprising at least forty exercises; (b) instruction by lecture table demonstrations, to be used mainly as a basis for questioning upon the general principles involved in the pupil's laboratory investigations; (c) the study of at least one standard text book, to the end that the pupil may gain a comprehensive and connected view of the most important facts and laws of elementary chemistry. 1 unit.

Students, properly qualified, will be examined in Elementary Chemistry on the first Saturday of the term; those passing the examination will be privileged to omit Elementary Chemistry (390) and will, instead, take Chemistry (393) and Chemical Laboratory (393a) during the first term.

DRAWING

FREEHAND DRAWING. Sketching of simple geometrical figures, of objects, and from copy. At least twenty plates must be submitted. ½ unit.

MECHANICAL DRAWING. The use of instruments and the preparation of at least twenty plates, illustrating the elements of descriptive geometry or simple machine parts. ½ unit.

PHYSIOGRAPHY

PHYSIOGRAPHY. The study of a standard text-book in physical geography, that a knowledge may be gained of the essential principles, and of well-selected facts illustrating those principles. Individual laboratory work, comprising at least forty exercises with notebook, is recommended. ½ or 1 unit.

BOTANY

BOTANY. An amount equal to that contained in Bergen's *Foundations of Botany* with laboratory work. ½ or 1 unit.

PHYSIOLOGY AND HYGIENE

PHYSIOLOGY AND HYGIENE. A course covering approximately what is given in such a text-book as Huxley & Youman's *Physiology and Hygiene.* ½ or 1 unit.

ZOÖLOGY

ZOÖLOGY. The equivalent of Jordan, Kellogg & Heath's *Animal Studies* with laboratory work. ½ or 1 unit.

MANUAL TRAINING

MANUAL TRAINING. Shop work in wood or metal in schools giving courses in manual training. ½ or 1 unit.

BOOKKEEPING, TYPEWRITING AND STENOGRAPHY

BOOKKEEPING, TYPEWRITING AND STENOGRAPHY, covering a formal course of study at school. 1 or 2 units.

DATES OF EXAMINATIONS

Examinations for admission to the University are held in June and September in the following order:

First Day.—Geometry, 8 A.M.; Physics, Ancient History, 2 P.M.

Second Day—Elementary Algebra, *A*, 8 A.M. to 10 A.M., Elementary Algebra, *B*, 10 A.M. to 12 M.; Trigonometry, 2 P.M.

Third Day.—Latin, 8 A.M.; German, French, Spanish, Greek, 2 P.M.

Fourth Day.—English, 8:30 A.M.; History, 2 P.M.

The dates for 1922 and 1923 are as follows: in 1922, Wednesday, Thursday, Friday and Saturday, June 14, 15, 16 and 17; and Friday, Saturday, Monday and Tuesday, September 15, 16, 18 and 19; in 1923, June 13, 14, 15 and 16, and September 14, 15, 17 and 18.

Examinations in subjects presented for elective units may be arranged for by correspondence with the Registrar.

Candidates for admission wishing to take examinations in any advanced subject for credit should notify the Registrar before September 1.

Certificates of the College Entrance Examination Board are accepted instead of the entrance examinations held at the University in those subjects in which the recorded grade is 60 per cent. or over.

ADMISSION TO ADVANCED STANDING

A candidate for admission to advanced standing in any course must meet the entrance requirements and in addition pass examinations in the work already done by the class which he desires to enter. These examinations are held in September, in the week preceding the opening of the University.

A student from another college or university is admitted without entrance examinations, provided he presents satisfactory credentials that he has covered the entrance subjects required at this University and has attended another college or university for one or more complete terms, evidence of which should be filed with the Registrar. If a student has been dropped from another college or university, he must present his record to the Committee on Standing of Students and terms of admission will be fixed.

Applicants who have obtained a certificate that the entrance requirements of the University are satisfied are advised to report personally to the Secretary of the Faculty. The Secretary of the Faculty will issue to the applicant a paper authorizing him to confer with the professors regarding the subjects for which he desires credit. It is necessary for an applicant to bring a certificate naming the subjects completed at another college, together with a copy of the catalogue or register of the college; and it is desirable for him to bring his drawings, field notes, computations and laboratory notebooks for inspection, and personal certificates from his teachers showing the grades attained at the college from which he comes. Professors may admit the student to advanced studies if satisfied with these evidences of proficiency, or they may require formal examinations in the subjects for which he desires credits.

Graduates of other colleges having the Bachelor's degree or its equivalent are similarly admitted to engineering courses. The length of time for the completion of a course will depend upon the student's attainments at entrance and his ability. Every opportunity is given for the completion of a course in minimum time.

A student who anticipates taking a technical course at Lehigh University after graduation from college should so arrange his work in college as to cover as many as possible of the subjects of the Freshman and Sophomore years of the technical course he intends to enter.

ADMISSION TO GRADUATE COURSES

Graduates of Lehigh University and others having satisfactory degrees conferred elsewhere may be admitted to advanced studies as outlined on page 133.

SCHOOL CERTIFICATES

Lehigh University has no permanent arrangement with any school whereby certificates are accepted instead of entrance examinations.

Applicants for admission on certificate should request their school principals to send to the Registrar as soon as the school closes in June a complete record of their work. Blanks for this purpose are supplied by the University.

Certificates are accepted in subjects in which records are satisfactory to the professors concerned and in which the work has been completed within reasonable time limits.

For admission to the College of Engineering records in mathematical subjects are accepted only if there is evidence of some satisfactory school study of mathematics completed not earlier than January of the entrance year.

For admission to the College of Arts and Science and to the College of Business Administration records in mathematical subjects are accepted only if there is evidence of some satisfactory school study of mathematics completed not earlier than June of the year preceding the entrance year.

For admission to the College of Engineering, to the College of Arts and Science and to the College of Business Administration records in the required foreign language are accepted only if there is evidence of some satisfactory school study of the language completed not earlier than January of the year preceding the entrance year.

EXAMINATIONS AT SCHOOLS

Upon the request of school principals the June entrance examinations may be held at schools on the regularly scheduled dates. Requests for examination papers should be sent to the Registrar before June 1.

THE COLLEGE OF ARTS AND SCIENCE

The College of Arts and Science of Lehigh University represents the traditional college course, modified to meet the needs of modern life and thought. Such a course is, in its purpose, primarily informing and cultural, not vocational; it seeks to gratify intellectual curiosity, to cultivate a love of learning, to impart the knowledge and discipline which are essential to intelligent and forceful living. It has besides certain specific uses: it is the customary approach to the professions of medicine, law, theology and teaching, and the usual basis for graduate study for higher degrees.

The entrance requirements are liberal, and such as may be met readily by graduates of Pennsylvania high schools of the first class. A statement of them may be found on page 18.

The plan of study comprises required subjects and unassigned or elective subjects. The required and elective subjects occupy respectively about two-thirds and one-third of the course. The required studies embrace courses in the English, German and French languages and literatures (two years each), mathematics (trigonometry and solid geometry), chemistry (elementary chemistry and qualitative analysis), economics, history, psychology, biology, geology, and philosophy, subjects which may be regarded as fundamental to the nature and purpose of the course.

The studies of the Freshman year follow in general the subjects which have been presented for entrance. After the Freshman year the course becomes increasingly elective, a minimum of three hours weekly of electives being allowed in the Sophomore year, six in the Junior year and ten in the Senior year. An appointed member of the Faculty counsels students in the choice of their studies and keeps before them the importance of selecting their work according to a definite and consecutive plan. Students are dealt with individually rather than in groups, and the effort is made to suit the studies of each to his qualifications and purpose.

The minimum course of study comprises fifteen scholastic hours or periods weekly. Work is assigned on the assumption that two hours are required by the average student to prepare adequately for a recitation. Students of proved ability, how-

ever, are not limited to this minimum after the Freshman year, and even in that year an entering student may increase his course in chemistry from three to four hours, if, as in the case of those who are preparing for the study of medicine, there is good reason. In general, the College aims at a reasonable amount of work well done, rather than a large amount indifferently done.

Instruction is given by lectures, by recitations, by the assignments of readings and topics for study and dissertations, and, when the subject admits of it, by practical work in field or laboratory. Field work or laboratory work accompanies courses in geology, physics, chemistry, biology, psychology, and allied subjects; students in advanced mathematics use, in their study of astronomy, the telescope and other instruments of the Sayre Observatory. Practice in teaching is provided in the schools of the vicinity for those who expect to follow teaching. Students residing at Leonard Hall who are preparing, under the direction of the Bishop of the Episcopal Diocese of Bethlehem, for the theological seminary have opportunity for practical religious work.

In the following plan of study the unassigned hours are filled by subjects selected from the listed elective studies. These are not necessarily confined to the year to which in the lists they are assigned, but may be taken earlier or subsequently. But this privilege is limited by considerations of the roster and the principle that the course of each student shall be systematic and not haphazard.

Students who enter with full entrance requirements in Latin and Greek (four and three units) will ordinarily continue these studies during the Freshman year. A class in Beginners' Greek, open to Freshmen and Sophomores, is formed in alternate years. Students who begin Greek in College will ordinarily pursue the study of Greek for three years.

The degree of Bachelor of Arts (B.A.) is conferred upon graduates of the College of Arts and Science.

THE COURSE IN ARTS AND SCIENCE

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
English	120, 121	(3)	3	6	9	English	122, 125	(3)	3	6	9
Plane Trig.	141	(3)	3	6	9	Solid Geom.	140	(3)	3	6	9
German or French	77 or 70 / 98	(3)	3	6	9	German or French	77 or 71 / 99	(3)	3	6	9
Latin or A. & M. Civil.	45 / 47	(3)	3	6	9	Latin or A. & M. Civil.	46 / 47	(3)	3	6	9
Greek or Chem.&Lab.	55 or 64 / 390, 392	(3)	3	6	9	Greek or Chem.	56 or 64 / 395	(3)	3	6	9
M.S. & P.E.	470, 500	(2)	4	2	6	M.S. & P.E.	470, 500	(2)	4	2	6

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
English	123	(3)	3	6	9	English	124	(3)	3	6	9
Economics	16	(3)	3	6	9	Economics	17	(3)	3	6	9
Latin or Greek or Phys.	48 / 57 / 327	(3)	3	6	9	Latin or Greek or Phys.	49 / 58 / 327	(3)	3	6	9
German or French	78 or 77 / 100	(3)	3	6	9	German or French	79 or 77 / 101	(3)	3	6	9
M.S. & P.E.	471, 500	(2)	4	2	6	M.S. & P.E.	471, 500	(2)	4	2	6
Electives		(3)			9	Electives		(3)			9

JUNIOR YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Psychology	1	(3)	3	6	9	Psychology	1	(3)	3	6	9
French or German	90 or 98 / 70	(3)	3	6	9	French or German	90 or 99 / 71	(3)	3	6	9
Biology	292	(3)	5	4	9	Gen. Geology	268	(2)	2	3	5
Physical Ed.	500	(1)	2	0	2	Geol. Lab.	269	(1)	2	2	4
Electives		(6)			18	Physical Ed.	500	(1)	2	0	2
						Electives		(6)			18

SENIOR YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Philosophy	7	(2)	2	4	6	Philosophy	8	(2)	2	4	6
French or German	97 or 100 / 77	(3)	3	6	9	French or German	97 or 101 / 77	(3)	3	6	9
Physical Ed.	500	(1)	2	0	2	Physical Ed.	500	(1)	2	0	2
Electives		(10)			30	Electives		(10)			30

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

ELECTIVE STUDIES

In order that elective subjects may be incorporated, so far as possible, in the University roster from term to term without conflicts, students are required to submit their electives to the Professor in charge of electives, for the first term on or before May 1, for the second term on or before December 1.

SOPHOMORE ELECTIVES

FIRST TERM		SECOND TERM	
Advanced Algebra (4)	143	Plane Analytic Geom. (3)	145
European History (3)	41	European History (3)	42
Elementary Mechanics (3)	320	Mechanics & Heat (3)	321
Latin (3)	48	Latin (3)	49
Greek (3)	64 or 65	Greek (3)	64 or 65
Advanced Chemistry (3)	398	Advanced Chemistry (3)	399
Economic Geography (3)	35	Economic Geography (3)	35
Physiography (2)	277	Physiography (2)	278
French (3)	92	French (3)	92
or German (3)	70	or German (3)	71
History of Education (3)	10	Scientific Method (3)	9
		Physical Measurements (1)	322
		Spherical Trigonometry (1)	142
		Stoichiometry (1)	397

JUNIOR ELECTIVES

FIRST TERM		SECOND TERM	
U. S. History (3)	39	U. S. History (3)	40
Latin (3)	50 or 52	Latin (3)	51 or 53
Greek (3)	55, 59 or 61	Greek (3)	56, 60 or 62
French (3)	98, 100 or 102	French (3)	99, 101 or 102
or German (3)	78, 77 or 80	or German (3)	79, 77 or 80
Spanish (3)	110	Spanish (3)	110
Dif. Cal. & S. A. Geom. (4)	146	Integral Calculus (4)	147
Higher Algebra (1)	144	Light & Sound (3)	325
Elec. & Magnetism (3)	323	Light, Elec. & Mag. Lab. (1)	326
Mech. & Heat Lab. (1)	324	Quantitative Analysis(4)	403,405
Quantitative Analysis(4)	401,402	Constitutional Law (3)	33
Constitutional Law (3)	33	Comparative Anatomy (3)	293
English (3)	126	English (3)	128
Mineralogy (4)	266	Education (3)	12
Education (3)	10 or 11	Italian (3)	117
Italian (3)	117	Economic Geography (3)	36
Economic Geography (3)	36	Business Law (2)	32
Business Law (2)	31	Labor Legislation (3)	23
Labor Legislation (3)	23	Geological Lab. (2)	269

SENIOR ELECTIVES

FIRST TERM		SECOND TERM	
Latin (3)	50 or 52	Latin (3)	51 or 53
Greek (3)	57, 59 or 61	Greek (3)	58, 60 or 62
German (3)	81 or 82	German (3)	81 or 82
French (3)	100, 102, 103 or 104	French (3)	101, 102, 103 or 104
Italian (3)	118	Italian (3)	118
Spanish (3)	114	Spanish (3)	114
English (3)	130 or 132	English (3)	131 or 134
Organic Chemistry (5)	408, 409	Organic Chemistry (5)	410, 411
Banking (3)	27	Banking (3)	27
Education (3)	13	Education (3)	13
Embryology (3)	294	Botany (3)	290
Bacteriology (2)	296	Physiology (2)	298
Psychological Problems (2)	3	Advanced Bacteriology (2)	297
Finance (3)	19	Social Psychology (2)	4
International Law (3)	34	Finance (3)	19
Physics (3)	332	International Law (3)	34
Analytic Mechanics (2)	149	Physics (3)	332
Field Geology (3)	275	Astronomy (3)	150
Petrography (2)	276	Paleontology (3)	272
Differential Equations (1)	148	Geology of N. A. (3)	273
Adv. Elec. & Mag. (2)	328	Electrical Laboratory (1)	330
Electrical Laboratory (1)	329	Analytic Mechanics (3)	152
Economic Thought (3)	24	Economic Thought (3)	24

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

PREPARATION FOR ENGINEERING COURSES

If a student in the College of Arts and Science contemplates becoming a candidate for a degree in technology after completion of his B.A. course, he should choose as electives during the third and fourth years of his B.A. course such science studies as are contained in the first and second years of the technical course which he wishes afterwards to complete. By carefully selecting electives, with the advice and guidance of the head of his department and the professor in charge of the technical course concerned, the graduate of the B.A. course may enter the technical course chosen as a Junior in full standing, and obtain his technical degree in two years of further study.

PRE-MEDICAL COURSES

Certain medical schools require for entrance a college course in addition to a high school course; others require a high school course yielding fourteen or more college entrance credits and at least two years in a college of liberal arts with about

three-fourths of the study devoted to chemistry, physics and biology.

The following four-year course has been prepared for students who intend to enter a medical school, but plan, before doing so, to complete their college course and obtain their degree.

THE PRE-MEDICAL COURSE

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
English	120, 121	(3)	3	6	9	English	122, 125	(3)	3	6	9
Plane Trig.	141	(3)	3	6	9	Solid Geom.	140	(3)	3	6	9
German or French	77 or 70, 98	(3)	3	6	9	German or French	77 or 71, 99	(3)	3	6	9
Latin or A. & M. Civil.	45, 47	(3)	3	6	9	Latin or A. & M. Civil.	46, 47	(3)	3	6	9
Chemistry	390	(2)	2	4	6	Qual. Anal.	395	(3)	6	0	6
Chem. Lab.	391	(2)	6	0	6	Stoichiometry	397	(1)	1	2	3
M.S. & P.E.	470, 500	(2)	4	2	6	M.S. & P.E.	470, 500	(2)	4	2	6

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
English	123	(3)	3	6	9	English	124	(3)	3	6	9
German or French	78 or 77, 100	(3)	3	6	9	German or French	79 or 77, 101	(3)	3	6	9
Economics	16	(3)	3	6	9	Economics	17	(3)	3	6	9
Physics	327	(3)	5	4	9	Physics	327	(3)	5	4	9
Adv. Chem.	398	(3)	3	3	6	Adv. Chem.	399	(3)	3	6	9
M.S. & P.E.	471, 500	(2)	4	2	6	M.S. & P.E.	471, 500	(2)	4	2	6

JUNIOR YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Psychology	1	(3)	3	6	9	Psychology	1	(3)	3	6	9
French or German	90 or 98, 70	(3)	3	6	9	French or German	90 or 99, 71	(3)	3	6	9
Biology	292	(5)	9	6	15	Comp. Anat.	293	(3)	5	4	9
Quant. Anal.	400	(3)	9	0	9	Quant. Anal.	404	(3)	9	0	9
Quant. An. Conf.	402	(1)	1	2	3	Quant. An. Conf.	405	(1)	1	2	3
Physics	335	(2)	2	4	6	Physics	335	(2)	2	4	6
Physical Ed.	500	(1)	2	0	2	Physical Ed.	500	(1)	2	0	2

SENIOR YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Philosophy	7	(2)	2	4	6	Philosophy	8	(2)	2	4	6
French or German	97 or 100, 77	(3)	3	6	9	French or German	97 or 101, 77	(3)	3	6	9
Org. Chem.	408	(3)	3	6	9	Org. Chem.	410	(3)	3	6	9
Org. Chem. Lab.	409	(2)	6	0	6	Org. Chem. Lab.	411	(2)	6	0	6
Embryology	294	(3)	5	4	9	Botany	290	(3)	4	4	8
Bacteriology	296	(2)	3	3	6	Psychology	4, 6	(3)	3	6	9
Physical Ed.	500	(1)	2	0	2	Physical Ed.	500	(1)	2	0	2

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

For students who cannot devote four years to college work, preparatory to entering upon the study of medicine, there may be arranged upon consultation, a course which will give the student the credits demanded by the medical schools for admission.

COURSES FOR TEACHERS

In the course leading to the degree of Bachelor of Arts, outlined on pages 32 to 36, the student may, through a selection of suitable electives, equip himself to teach in high school the subject or subjects he has selected as his specialty, whether in the field of English, of ancient or modern language, of history, of biology and chemistry, of physics and mathematics, or of physiography and related subjects. In the course in Business Administration he is permitted to substitute, during the Junior and Senior years, courses in distinctly pedagogical subjects sufficient to make a total of fifteen term hours. He may thus equip himself to teach in secondary schools the important branches of commerce and industry.

No one may teach in the public schools of any state without first securing a license from that state. In Pennsylvania, as in most states, the special examination for such a license is waived in the case of college graduates, provided they have completed a certain number of hours in distinctly pedagogical studies, and have applied for a provisional college certificate to teach. At the end of three years of successful experience in teaching the State of Pennsylvania issues a permanent college certificate. The requirement in this State for a provisional certificate calls for two hundred recitation hours in such studies as psychology, history of education, school management, methods of teaching, logic and ethics. The wish is general, however, among superintendents and principals that the graduate, when he begins to teach, shall have completed a much larger amount of distinctly pedagogical study than the law now demands, and that he shall have had some experience in observation and practice teaching.

Lehigh has endeavored to meet this wish. The University Department of Education has worked out a system of giving students opportunities in observation and practice teaching. Through the courtesy and liberal spirit of Boards of Education and Superintendents of Public Schools, and through the University's close association with private schools, the system of practice teaching has been made in a measure adjustable to the needs of students with different aims and at different stages in their development of teaching power.

The course in Education at Lehigh may be outlined as follows:

FIRST TERM	SOPHOMORE YEAR	SECOND TERM	
History of Education (3)	10	Scientific Method (3)	9
FIRST TERM	**JUNIOR YEAR**	**SECOND TERM**	
General Psychology (3)	1	General Psychology (3)	1
Secondary Education (3)	11, 14	Secondary Education (3)	12, 14
FIRST TERM	**SENIOR YEAR**	**SECOND TERM**	
Special Method (3)	13, 14	Special Method (3)	13, 14

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

The courses in Psychological Problems, Social Psychology and History of Philosophy also throw considerable light upon the true purposes of education and the methods by which to secure them.

Graduates from state normal schools will, under the conditions prescribed by the State Department of Education, receive credit for equivalent studies in the field of education completed in the normal schools.

THE COLLEGE OF BUSINESS ADMINISTRATION

Requirements for admission to the College of Business Administration are given on page 19.

The aim of the Course in Business Administration is to provide a sound understanding of the structure, organization and functioning of industry, commerce and finance, and of the general causes and criteria of prosperity and depression. A study is made of the functions common to all business enterprises and of the general principles of administration. The student is shown the relation of the business executive to the various factors of business organization and control.

In addition to providing a broad training for business, this course gives opportunity to specialize in some one branch of business and to prepare for the study of law and for public service. The following groupings of subjects suggest the opportunities for specialized work:

PREPARATION FOR THE LAW

Advisers: Professor Stewart and Assistant Professor MacGregor

Business Law
Constitutional Law
International Law
Economics
Accounting Theory and Practice
Corporation Accounting
Statistics
Finance
Banking and Currency
Investments
Labor Legislation and Administration
Transportation
Psychology

ACCOUNTANCY

Advisers: Professor Stewart and Associate Professor Bickley

Accounting Theory and Practice
Corporation Accounting
Cost Accounting
Economics
Business Law
Constitutional Law
Statistics
Finance
Banking and Currency
Investments
Industrial Management
Transportation

FINANCE, BANKING AND INVESTMENT BUSINESS

Advisers: Professor Stewart and Assistant Professor Curtis

Finance
Banking and Currency
Investments
Statistics
Economics
Accounting Theory and Practice
Corporation Accounting
Business Law
Transportation
Constitutional Law
Economic Geography
Industrial Management
Labor Legislation and Administration

INDUSTRIAL ADMINISTRATION

Advisers: Professor Stewart and Associate Professor Bickley

Accounting Theory and Practice
Corporation Accounting
Cost Accounting
Economics
Industrial History
Economic Geography
Engineering Drawing
Psychology
Industrial Management
Labor Legislation and Administration
Business Law
Constitutional Law
Transportation
Statistics
Finance
Investments
Electives from Courses in Engineering and Chemistry

FOREIGN TRADE

Advisers: Professors Stewart and Fox, Assistant Professor Curtis

Economic Geography of the Western Hemisphere
Economic Geography of the Eastern Hemisphere
Economics
Spanish
Statistics
Business Law
International Law
Constitutional Law
Finance
Banking and Currency
Investments
Accounting Theory and Practice
Corporation Accounting

The work of the College covers four years. On its completion the degree of Bachelor of Science in Business Administration is given.

THE COURSE IN BUSINESS ADMINISTRATION

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T
English	120, 121	(3)	3	6	9
Spanish or Portuguese	110 or 111 / 115	(3)	3	6	9
Indus. Hist.	38	(4)	4	8	12
Plane Trig.	141	(3)	3	6	9
Engr. Draw.	160	(3)	7	1	8
M.S. & P.E.	470, 500	(2)	4	2	6

SECOND TERM	N	C	R	P	T
English	122, 125	(3)	3	6	9
Spanish or Portuguese	110 or 111 / 115	(3)	3	6	9
Indus. Hist.	38	(4)	4	8	12
Solid Geom.	140	(3)	3	6	9
Engr. Draw.	161	(2)	5	1	6
M.S. & P.E.	470, 500	(2)	4	2	6

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T
Physiography	277	(2)	2	4	6
Accounting	20	(3)	3	6	9
Const. Law	33	(3)	3	6	9
Economics	16	(3)	3	6	9
Ec. Geog. N. & S. A.	35	(3)	3	6	9
Spanish or Portuguese	112 or 113 / 116	(3)	3	6	9
M.S. & P.E.	471, 500	(2)	4	2	6

SECOND TERM	N	C	R	P	T
Physiography	278	(2)	2	4	6
Accounting	20	(3)	3	6	9
Const. Law	33	(3)	3	6	9
Economics	17	(3)	3	6	9
Ec. Geog. N. & S. A.	35	(3)	3	6	9
Spanish or Portuguese	112 or 113 / 116	(3)	3	6	9
M.S. & P.E.	471, 500	(2)	4	2	6

JUNIOR YEAR

FIRST TERM	N	C	R	P	T
Bus. Law	31	(2)	2	4	6
U. S. Hist.	39	(3)	3	6	9
Labor Legis.	23	(3)	3	6	9
Transportation	22	(2)	2	4	6
Statistics	26	(3)	3	6	9
Corp. Acct. (Elec.)	21	(3)	3	9	12
Corp. Fin. (Elec.)	18a	(3)	3	8	11
Ec. Geog. E. H.	36	(3)	3	6	9
Psychology	2	(2)	2	4	6
Physical Ed.	500	(1)	2	0	2

SECOND TERM	N	C	R	P	T
Bus. Law	32	(2)	2	4	6
U. S. Hist.	40	(3)	3	6	9
Labor Legis.	23	(3)	3	6	9
Transportation	22	(2)	2	4	6
Statistics	26	(3)	3	6	9
Corp. Acct. (Elec.)	21	(3)	3	9	12
Corp. Fin. (Elec.)	18a	(3)	3	8	11
Ec. Geog. E. H.	36	(3)	3	6	9
Psychology	2	(2)	2	4	6
Physical Ed.	500	(1)	2	0	2

SENIOR YEAR

FIRST TERM	N	C	R	P	T
Finance	19	(3)	3	6	9
Bank. & Cur.	27	(3)	3	6	9
Investments	25	(3)	3	6	9
Audit. (Elec.)	21a	(3)	3	9	12
European Hist.	41	(3)	3	6	9
Internat. Law.	34	(3)	3	6	9
Econ. Thought	24	(3)	3	6	9
Physical Ed.	500	(1)	2	0	2

SECOND TERM	N	C	R	P	T
Finance	19	(3)	3	6	9
Bank. & Cur.	27	(3)	3	6	9
Investments	25	(3)	3	6	9
Cost Acct. (Elec.)	21b	(3)	3	9	12
European Hist.	42	(3)	3	6	9
Internat. Law.	34	(3)	3	6	9
Econ. Thought	24	(3)	3	6	9
Thesis					
Physical Ed.	500	(1)	2	0	2

Students may, with the approval of the Faculty, substitute for some of the subjects in the Junior and Senior years, other subjects which will better suit their future aims.

Prospective teachers should in this connection read the statement concerning Courses for Teachers.

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

THE COLLEGE OF ENGINEERING

THE COURSE IN CIVIL ENGINEERING

The requirements for admission to the Course in Civil Engineering are given on page 20.

The purpose of this course is to give a broad education in those general and scientific subjects which form the foundation of all branches of technology, and special training in those subjects comprised under the term of Civil Engineering. The Department aims to teach young men how to think and how to attack new problems, to impress upon them the underlying principles of engineering and to inspire them with a desire to do their best work.

The Freshman year is devoted mostly to fundamental studies which give both general culture and preparation for the technical work of the following years. Mathematics, physics, modern languages, military science and tactics, and chemistry are given throughout both terms. Students continue in the Freshman year the modern foreign language accepted for entrance. Drawing is done during the second term of the Freshman year and throughout the entire Sophomore year.

Land, Topographic and Railroad Surveying is given in the five weeks following the end of the Sophomore year. By this arrangement the attention of students is concentrated upon surveying, thus enabling practical field operations to be exemplified in the best manner. In Geodetic Surveying, given in the Senior year, triangulations of a high degree of precision are executed, also determinations of azimuth and adjustments of the results are made by standard methods. A large collection of levels, transits and other surveying instruments enables the students to become familiar with instruments of the best type.

Among other required subjects is Strength of Materials, which presents the theory of beams, columns and shafts, and the methods of computing and designing them. Laboratory tests are made of timber, brick, iron and steel. Strength of Materials as here presented may be described as applied mechanics, that is, the application of mechanics to the design of

engineering structures. The testing of materials is of great importance for the student's understanding of the mechanics of engineering and for the capacity it gives him to manipulate apparatus and to handle machines.

Roofs and Bridges receive attention throughout three terms. Analytical and graphic methods of determining stresses are taken up in Roofs and Bridges of the second term of the Junior year and in Bridge and Structural Design and Higher Structures of the Senior year. Visits are made to bridges and to bridge shops. In the Senior year designs and working drawings are prepared by each student for both a highway and a railroad bridge. Some of these drawings are made in the same manner as in drawing rooms of bridge companies and others are general, that is, design drawings only. The theory of cantilever, draw, suspension and arch structures receives detailed attention. The design and construction of reinforced concrete and foundations are given in the second term of the Senior year in the course in Reinforced Concrete Design and Foundations. This extended training in structural engineering furnishes a foundation for structural steel and reinforced concrete work in practice.

Hydraulic Engineering and Sanitary Engineering are treated at length. The theory of the flow of water through orifices, weirs, pipes and channels together with the principles of hydraulic motors is given in the Junior year, the work being supplemented by testing in the hydraulic laboratory. In the Senior year the subjects of water supply, water power and sewerage are discussed. The methods of collecting, purifying and distributing water are explained and compared; house drainage, the design of sewerage systems and the disposal of sewage also receive attention. Computations for dams, standpipes, sewers and other appurtenances are made. Canal engineering, river and harbor work and land drainage are studied: irrigation by both water and sewage are discussed. This training in Hydraulics and Sanitary Engineering subjects, including Sanitary Biology of the Senior year, is planned to enable a graduate to enter upon the work of city engineering. In connection with the course in hydraulics, measurements are made of the flow in the Lehigh River, the Lehigh Canal and other streams in the vicinity of Bethlehem and the data thus obtained are studied later and reports written thereon. In view

of the increasing importance of water power development this work is of value and interest.

The content of the courses in Highway Engineering and Railroads are planned to prepare a student to enter the field of highway construction and design, and railroad work.

Contracts and Specifications of the second term of the Senior year is presented by the Civil Engineering Department more from the engineering than from the legal viewpoint. This course, consisting of two lectures a week, gives the essential features of contracts and the form and scope of contracts and specifications as used in building engineering works.

Beside work pertaining strictly to Civil Engineering, a liberal amount of time is devoted to such allied subjects as mineralogy, geology, metallurgy, dynamos and motors, and heat engines. Also a course in Business Engineering, comprising economics, accounting, business law and finance, is given throughout the Senior year.

A description of the Fritz Engineering Laboratory which is operated by the Civil Engineering Department is given in this Register under the heading of Buildings.

The student who completes this course receives the degree of Civil Engineer (C.E.). Mature young men, if properly qualified, may take special studies without being candidates for the degree. Graduates of this course may become candidates for the degree of Master of Science under the regulations stated elsewhere in this Register.

THE COURSE IN CIVIL ENGINEERING

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Adv. Algebra	143	(4)	4	8	12	P. Anal. Geom.	145	(3)	3	6	9
Chemistry	390	(2)	2	4	6	Qual. Anal.	395	(2)	6	0	6
Chem. Lab.	391	(2)	6	0	6	Stoichiometry	397	(1)	1	2	3
El. Mechanics	320	(3)	3	5	8	El. Mechanics	321	(3)	3	4	7
French / or German / or Spanish	94 / 75 / 111	(3)	3	6	9	Phys. Measure	322	(1)	3	2	5
English	120	(2)	2	2	4	French / or German / or Spanish	94 / 75 / 111	(3)	3	5	8
M.S. & P.E.	470, 500	(2)	4	2	6	English	122	(2)	2	2	4
						Drawing	162	(1)	3	0	3
						M.S. & P.E.	470, 500	(2)	4	2	6

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3)

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Cal. & S.A.Geom.	146	(4)	4	8	12	Int. Calculus	147	(4)	4	8	12
Elec. & Mag.	323	(3)	3	4	7	Light & Sound.	325	(3)	3	4	7
M. & H. Lab.	324	(1)	2	1	3	L., E. & M. Lab.	326	(1)	2	1	3
Mineralogy	266	(4)	6	3	9	Gen. Geology	268	(2)	2	3	5
Heat Eng.	221	(3)	3	6	9	Geol. Lab.	269	(2)	4	3	7
Engr. Drawing.	163	(3)	7	1	8	Heat Eng.	222	(3)	3	6	9
M.S. & P.E.	471, 500	(2)	4	2	6	Engr. Drawing.	164	(2)	5	0	5
						M.S. & P.E.	471, 500	(2)	4	2	6

SUMMER TERM: Land and Topographic Surveying, 165, 3 weeks (1½); Railroad Surveying, 166, 2 weeks (1½)

JUNIOR YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Str. of Mat.	167	(4)	4	8	12	Hydraulics	170	(3)	3	6	9
Str. Mat. Lab.	168	(1)	3	0	3	Hyd. Lab.	171	(1)	3	0	3
Anal. Mech.	149	(2)	2	4	6	Roofs & Bridges.	172	(4)	4	8	12
Railroads	169	(4)	8	2	10	Astronomy	150	(3)	3	6	9
Metallurgy	247	(3)	3	4	7	Alt. Cur.	375	(2)	2	4	6
Dyn. & Mot.	354	(2)	2	4	6	Dyn. Lab.	356	(1)	3	1	4
Dyn. Lab.	355	(1)	3	1	4	Highway Engr.	173	(3)	5	2	7
Physical Ed.	500	(1)	2	0	2	Physical Ed.	500	(1)	2	0	2

SUMMER TERMS Shop Work or Engineering Construction, with report, 187, 8 weeks (3)

SENIOR YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Str. Steel Des.	175	(3)	3	6	9	Higher Structures.	182	(3)	3	6	9
Br. Des. Dr.	177	(3)	9	0	9	R. Con. D. & F.	183	(3)	3	6	9
Hyd.& W.P. Engr.	179	(4)	5	7	12	Cement Lab.	184	(1)	3	0	3
Geodesy / or Pract. Astr.	180 / 151	(3)	6	2	8	San. Engr.	186	(3)	3	6	9
		(3)	3	6	9	San. Biol.	295	(2)	3	5	8
Bus. Engr.	30a	(3)	3	3	6	English	137	(3)	3	3	6
R. R.s & Ter.	181	(3)	3	3	6	or Con. & Spec.	185	(2)	2	4	6
Physical Ed.	500	(1)	2	0	2	Bus. Engr.	30a	(3)	3	3	6
						Physical Ed.	500	(1)	2	0	2

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

THE COURSE IN MECHANICAL ENGINEERING

The requirements for admission to the Course in Mechanical Engineering are given on page 20.

The purpose of this course is to give young men a broad and thorough training in the fundamental subjects which underlie all engineering. The course is developed from the viewpoint that the engineer should be, first, a good, effective citizen, loyal and true to the community, and to the organization which he serves, and after that a professional man not only qualified to render service as an engineer of material, but equipped to cope with and carry forward the ethics of human engineering and leadership.

The Freshman year is given to fundamental studies in preparation for the technical work of the following years and to studies of general cultural value. The former comprise Advanced Algebra, Analytic Geometry, Elementary Chemistry with laboratory exercises, Qualitative Analysis, Stoichiometry, Elementary Mechanics, Heat, and laboratory work in Physical Measurements. The general studies are English, Military Science and Tactics, and modern languages,—French, German or Spanish. Students continue the language accepted for entrance.

At the close of the Freshman year, students attend the R. O. T. C. encampment for six weeks and hand in a report on the work at the beginning of the Sophomore year.

In the Sophomore year the following courses are given: Differential Calculus, Solid Analytic Geometry, Integral Calculus, Electricity and Magnetism, Light and Sound, Mechanism, Mechanical Drawing, Elementary Machine Design, and Steam Engines. The laboratory course covers mechanics, heat, light, electricity and magnetism. Military Science and Tactics is continued.

At the close of the Sophomore year students are required to spend eight weeks in an industrial plant and hand in a report at the beginning of the Junior year.

The courses given in the Junior year are Differential Equations, Analytic Mechanics, Strength of Materials, Graphic Statics of Mechanisms, Advanced Electricity and Magnetism, Heat Engines, Hydraulics, Metallurgy, Graphic Statics of Structures and Dynamos and Motors. Courses are given in

Engineering Laboratory and Electrical Laboratory; laboratory courses also accompany the study of Strength of Materials and Hydraulics.

At the close of the Junior year students are required to spend at least eight weeks on student apprenticeship work, shop work, or engineering construction as approved by the Department. A report is required.

The courses of the Senior year are Machine Design, Alternating Currents and Electrical Engineering, both accompanied by laboratory work, Mechanical Engineering, English, Business Engineering and Engineering Laboratory. A thesis is required.

The course in Mechanical Engineering is built upon the work of the Sophomore and Junior years and consists of Thermodynamics, Steam Turbines, Internal Combustion Engines, Air Machinery, Pumping Machinery and Refrigeration.

The course in Business Engineering comprises the elements of Economics, Accounting, Business Law and Finance.

Instruction in Machine Design is given throughout the Sophomore year. There is a thorough drill in projection drawing. Freehand sketches are first made and measurements taken of machine pieces; these sketches are then converted into full-sized drawings. There is then considerable practice in the interpretation of such drawings. This is followed by difficult projections and intersections and exercises in the proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice. In their Senior year the students undertake the calculations, estimates and working drawings involved in the design of simple but complete machines, the general plan of arrangement being given in the form of rough sketches, photographs or wood cuts. In the second term the Seniors make original designs for simple machinery.

After completing the general course in Physics, students in Mechanical Engineering take courses along electrical lines. The aim is a clear conception of electrical units and a working knowledge of resistance, impedance, reactance, capacity, the magnetism of iron and the magnetic circuit as used in the

construction of electrical machinery. Attention is then directed to the theory and calculation of direct current dynamos, to the study of variable and alternating current phenomena and to the theory of the alternating current apparatus. Practical problems show their application. The laboratory work involves tests of resistance, insulation, consumption of energy and efficiency.

The course in Engineering Laboratory begins with the handling and calibration of the instruments and appliances belonging to the experimental side of mechanical engineering. The simpler tests and experiments are taken up next, and there is a gradual progress toward complex operations such as the complete test of a power plant or pumping station, or a full thermodynamic test of the steam engine. The course is, at present, most fully developed in the field of steam engineering, where it embraces steam calorimetry, flow of steam, the testing of steam traps and separators; of injectors, pumps, and the steam turbine; extensive practice with the indicator, engine tests of various sorts and boiler testing.

Due place is given in the course to gas engineering, tests of gas producers, gas engines and oil engines, work with compressed air, tests of hot-air engines and various incidental appliances and apparatus. Dynamometer work includes experiments in friction and lubrication and determination of the efficiency of machines. The purpose of this course is to provide a system of well-selected and graded experiments which will illustrate and impress principles, develop the skill and judgment of the student and give training in the idea, method and detail of this sort of work.

In the Senior year one or two trips are made to New York or Philadelphia during which visits of inspection are made to power plants, municipal works, ship yards and a variety of industrial plants located in these cities or vicinity.

Graduates of this course receive the degree of Mechanical Engineer (M.E.).

THE COURSE IN MECHANICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Adv. Algebra	143	(4)	4	8	12	P. Anal. Geom.	145	(3)	3	6	9
Chemistry	390	(2)	2	4	6	Qual. Anal.	395	(3)	9	0	9
Chem. Lab.	391	(2)	6	0	6	Stoichiometry	397	(1)	1	2	3
El. Mechanics	320	(3)	3	5	8	El. Mechanics	321	(3)	3	4	7
French	94	(3)	3	6	9	Phys. Measure	322	(1)	3	2	5
or German	75					French	94	(3)	3	5	8
or Spanish	111					or German	75				
English	120	(2)	2	2	4	or Spanish	111				
M.S. & P.E.	470, 500	(2)	4	2	6	English	122	(2)	2	2	4
						M.S. & P.E.	470, 500	(2)	4	2	6

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3)

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Cal. & S.A.Geom.	146	(4)	4	8	12	Int. Calculus	147	(4)	4	8	12
Elec. & Mag.	323	(3)	3	4	7	Light & Sound	325	(3)	3	4	7
M. & H. Lab.	324	(1)	2	1	3	L., E. & M. Lab.	326	(1)	2	1	3
Dr. and El.M.Des.	200	(3)	6	3	9	El. Mach. Des.	203	(3)	3	6	9
Heat Eng.	201	(3)	3	6	9	Heat Eng.	204	(3)	3	6	9
Mechanism	202	(3)	3	5	8	Mechanism	205	(3)	3	5	8
M.S. & P.E.	471, 500	(2)	4	2	6	M.S. & P.E.	471, 500	(2)	4	2	6

SUMMER TERM: Work in Industrial Plant, with report, 8 weeks (3)

JUNIOR YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Diff. Equations	167a	(1)	1	3	4	Metallurgy	247	(3)	3	4	7
Anal. Mech.	149	(2)	2	4	6	Hydraulics	170a	(2)	2	4	6
Str. of Mat.	167a	(3)	3	6	9	Hyd. Lab.	171	(1)	3	0	3
Str. Mat. Lab.	168	(1)	3	0	3	Gr. St. & Surv.	174	(3)	3	6	9
Gr. St. of Mech.	206	(2)	4	0	4	Dyn. & Mot.	354	(2)	2	4	6
Adv. Elec. & Mag.	328	(2)	2	4	6	Elec. Lab.	330	(1)	3	1	4
Elec. Lab.	329	(1)	3	0	3	Heat Eng.	209	(4)	4	8	12
Heat Eng.	207	(4)	4	8	12	Engr. Lab.	210	(1)	3	0	3
Engr. Lab.	208	(1)	3	0	3	Physical Ed.	500	(1)	2	0	2
Physical Ed.	500	(1)	2	0	2						

SUMMER TERM: Student Apprenticeship or Engineering Construction or Shop Work, with report, 8 weeks (3)

SENIOR YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
English	123, 125	(3)	3	3	6	Mach. Design	215	(4)	4	8	12
Mach. Design	211	(4)	4	8	12	Elec. Engr.	361	(2)	2	4	6
Alt. Currents	375	(2)	2	4	6	Dyn. Lab.	356	(1)	3	1	4
Dyn. Lab.	355	(1)	3	1	4	Bus. Engr.	30a	(3)	3	3	6
Bus. Engr.	30a	(3)	3	3	6	Mech. Engr.	216	(4)	4	8	12
Mech. Engr.	212	(4)	4	8	12	Engr. Lab.	217	(1)	3	0	3
Engr. Lab.	213	(1)	3	0	3	Thesis	214	(3)	1	6	7
Physical Ed.	500	(1)	2	0	2	Physical Ed.	500	(1)	2	0	2

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

THE COURSE IN METALLURGY

The requirements for admission to the Course in Metallurgy are given on page 20.

This course is designed to prepare the student for practice in any or all directions in the field of metallurgy, such as the extraction of metals from their ores and the working and refining of metals. The two branches of this subject formerly comprised in the separate courses of Metallurgical Engineering and Electrometallurgy have been united, so that the graduate is properly equipped in both of these directions and may properly be designated as prepared in the whole field of metallurgy.

The basis of the course consists, necessarily, of fundamental and thorough training in mathematics, chemistry and physics, followed by such advanced chemistry as is useful to the metallurgist. These fundamental studies are not cut or restricted, but are given the full prominence which they should have in a metallurgist's education.

Collateral studies in other departments than metallurgy are liberally provided, such as Mineralogy, Blowpiping, General Geology, Geological Practice and Economic Geology in the Department of Geology; Mechanical Drawing and Ore Dressing in the Department of Mining Engineering; Advanced Electricity and Magnetism and Electrical Laboratory in the Department of Physics; Alternating Currents, Dynamos and Motors, Electrical Engineering and Dynamo Laboratory in the Department of Electrical Engineering; Heat Engines, comprising the study of boilers, steam engines, gas engines and internal combustion motors, and Engineering Laboratory, in the Department of Mechanical Engineering; Hydraulics and Strength of Materials, with laboratory testing, in the Department of Civil Engineering.

Instruction is given in English composition, writing and oratory. The study of German or French for one year is required, the student continuing the language on which he enters; if a student enters on Spanish he takes one year of German. The one year of either German or French is supplemented in the Senior year by a brief but intensive course in the grammar of the other language, and by readings in Metallurgical German and French with the staff of the Department of Metallurgy.

The studies in chemistry, which are so important to the

metallurgist, include Laboratory Experiments, Qualitative and Quantitative Analysis, both gravimetric and volumetric, of the more common ores and metallurgical products, including Gas Analysis and Assaying, along with courses in Stoichiometry, Advanced Chemistry, Physical Chemistry and Physical Chemistry Laboratory. This instruction, together with the course in Physics and Physical Laboratory, constitutes the foundation on which the metallurgical instruction is based.

The special instruction in Metallurgy is begun by introductory courses of lectures on the history of the metals, followed by a discussion of their economic and mechanical importance, their physical and chemical properties, including statistics of their production and details of the distribution of their ores and the geographical distribution and conditions of their production. In connection with this some visits are taken to near-by metallurgical plants to make the student familiar with the appearance and general outline of metallurgical apparatus. Courses of lectures extending over two years take up in detail the general principles of metallurgy and their applications to specific cases. They begin with the general physical and chemical principles utilized in extracting metals from their ores and the manner in which they are applied, and are followed by a course of lectures on the Metallurgy of Iron and Steel, and by another course in the Metallurgy of the other metals, copper, lead, silver, gold, etc., in which each metal is discussed in detail. In order to impress these principles upon the student and to render their application familiar, he is required to solve a series of problems dealing with practical details of the metallurgical processes in an exact and quantitative manner, the data being taken from practice and the results being intended to give an insight into the most fundamental metallurgical questions. A course of lectures follows this in the principles of electrochemistry, and their application in electrometallurgy, accompanied by laboratory investigations of these principles as well as the general principles of metallurgical processes, including methods of making physical and chemical measurements which are of value to the practicing metallurgist. A course in Metallography acquaints the student with the methods of studying with the microscope and other instruments of precision, the physical properties, constitution and structure of metals and alloys. The seminary in the Senior

year is intended to bring together the members of the Department and the students in the discussion of current metallurgical questions and problems, and students' theses.

The proximity of the works of the Bethlehem Steel Company and the kindness of its officers give opportunity for visits of inspection by the students in classes and individually, thus affording unusual facilities for the practical study of the metallurgy of iron and steel. Occasional visits of inspection are made to more distant works, in connection with the metallurgy of zinc, copper, lead, gold and silver.

Graduates of this course receive the degree of Metallurgical Engineer (Met.E.).

THE COURSE IN METALLURGY

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T
Adv. Algebra	143	(4)	4	8	12
Chemistry	390	(2)	2	4	6
Chem. Lab.	391	(2)	6	0	6
El. Mechanics	320	(3)	3	5	8
German or French	72 or 76 / 94	(3)	3	6	9
English	120	(2)	2	2	4
M.S. & P.E.	470, 500	(2)	4	2	6

SECOND TERM	N	C	R	P	T
P. Anal. Geom.	145	(3)	3	6	9
Qual. Anal.	395	(3)	9	0	9
Qual. An. Conf.	396	(1)	1	1	2
Stoichiometry	397	(1)	1	2	3
Hist. Metals	241	(1)	1	1	2
El. Mechanics	321	(3)	3	4	7
Phys. Measure	322	(1)	3	2	5
German or French	72 or 76 / 94	(3)	3	5	8
M.S. & P.E.	470, 500	(2)	4	2	6

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3)

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T
Cal. & S.A.Geom.	146	(4)	4	8	12
Adv. Chem.	398	(3)	3	3	6
Elec. & Mag.	323	(3)	3	4	7
M. & H. Lab.	324	(1)	2	1	3
Intro. Met.	242	(1)	1	1	2
Drawing	300	(2)	6	0	6
Mineralogy	266	(4)	6	3	9
B. P. Anal.	267	(1)	3	0	3
M.S. & P.E.	471, 500	(2)	4	2	6

SECOND TERM	N	C	R	P	T
Int. Calculus	147	(4)	4	8	12
Adv. Chem.	399	(3)	3	6	9
Light & Sound	325	(3)	3	4	7
L., E. & M. Lab.	326	(1)	2	1	3
Intro. Met.	242	(1)	1	1	2
Gen. Geology	268	(2)	2	3	5
Geol. Lab.	269	(2)	4	3	7
B. P. Anal.	267	(1)	3	0	3
M.S. & P.E.	471, 500	(2)	4	2	6

SUMMER TERM: Quantitative Analysis, 403a, 5 weeks (3)

JUNIOR YEAR

FIRST TERM	N	C	R	P	T
G.Met.&Probs.	243, 244	(3)	3	4	7
Phys. Chem.	419	(3)	3	3	6
Ore Dr. & Lab.	302	(3)	3	3	6
Adv. Elec. & Mag.	328	(2)	2	4	6
Elec. Lab.	329	(1)	3	0	3
Heat Eng.	221	(3)	3	6	9
Str. of Mat.	167a	(3)	3	6	9
Str. Mat. Lab.	168	(1)	3	0	3
Physical Ed.	500	(1)	2	0	2

SECOND TERM	N	C	R	P	T
I.&S. & Probs.	245, 246	(3)	3	4	7
Phys. Chem.	421	(2)	2	3	5
Dyn. & Mot.	354	(2)	2	3	5
Dyn. Lab.	355	(1)	3	1	4
Elec. Lab.	330	(1)	3	0	3
Heat Eng.	222	(3)	3	6	9
Hydraulics	170a	(2)	2	4	6
Hyd. Lab.	171	(1)	3	0	3
English	127	(4)	4	4	8
Physical Ed.	500	(1)	2	0	2

SUMMER TERM: Assaying, 413, 4 weeks (3)

SENIOR YEAR

FIRST TERM	N	C	R	P	T
N.F. Met.&Pr.	248, 249	(3)	3	4	7
Metallography	257	(3)	7	1	8
El. Chem.	252	(1)	1	2	3
El. Chem. Lab.	255	(1)	2	1	3
Seminary	258	(3)	4	2	6
Alt. Currents	375	(2)	2	3	5
Dyn. Lab.	356	(1)	3	1	4
Phys. Chem. Lab.	420	(1)	3	0	3
Engr. Lab.	220	(1)	3	0	3
French or Ger., 91 or 72		(3)	3	5	8
Physical Ed.	500	(1)	2	0	2

SECOND TERM	N	C	R	P	T
N.F. Met.&Pr.	250, 251	(3)	3	4	7
Met. Lab.	256	(2)	4	2	6
El. Met.	253	(1)	1	2	3
Seminary	258	(2)	3	0	3
Elec. Engr.	361	(2)	2	3	5
Dyn. Lab.	362	(1)	3	1	4
Eng. Lab.	226	(1)	3	0	3
Econ. Geol.	271	(4)	5	5	10
Thesis	259	(3)	1	8	9
Physical Ed.	500	(1)	2	0	2

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

THE COURSE IN MINING ENGINEERING

The requirements for admission to the Course in Mining Engineering are given on page 20.

The object of this course is primarily to train a student for practice in the field of mining engineering. It is designed to give him the thorough fundamental training of an engineer and a breadth of education that will enable him readily to undertake work in the various lines of engineering frequently presented to one of his profession.

The course, therefore, places the graduate in the path of a large number of opportunities. Not only will he have had sufficient practice and training to enter upon the field of mining, but he can pursue work in which geology and metallurgy play an important part, and also in related engineering projects.

In the Freshman year a foundation is laid in the fundamental subjects of mathematics, physics, chemistry, English and modern foreign languages. The modern language pursued is the one presented for entrance. Lectures are given in physiology and hygiene, also in military science and tactics. Military drill and systematic physical exercise are required. Students attend the R. O. T. C. camp at the close of the Freshman year.

The course in Drawing begins in the second term of the Freshman year. A student learns the use of drawing instruments, making tracings and blue prints, drawings of machine parts of simple construction, and solves problems in Descriptive Geometry.

The summer schools in Land and Topographic Surveying and in Mine and Railroad Surveying are held at the close of the Sophomore and Junior years respectively. The second of these schools is conducted partly in the mining regions; this gives practice in mine and railroad surveying and permits a study of mining operation and mining plants, from which data are secured exemplifying class room work and facilitating the course in Mining Design of the Senior year.

The course in Chemistry begins in the first term of the Freshman year and extends to the end of the Sophomore year, with the summer school in Assaying at the end of the Junior year. Beginning with an introduction to general chemical theory and

the elements, supplemented by laboratory work, the subject is continued by Qualitative and Quantitative Analysis. Chemical problems and reactions are taught in Stoichiometry. The instruction includes the analysis of common ores, fuels, gases and metallurgical products.

The course in Business Engineering in the Senior year aims to present to the student the several economic, commercial, administrative and legal aspects of conditions existing in the industrial world which are of particular concern to the engineering profession.

The importance of the conservation of the timber resources of the country and the preservation of wood against decay are treated in Forestry, together with the characteristics of the woods of the important timber species.

Mineralogy is introduced by a short course in Crystallography, in which models of crystals and mineral specimens are studied. The various means of identification are then applied to more difficult minerals, the determination of which may be assisted and effected by the work in Blowpipe Analysis.

In the courses in Geology, the student studies the forms and structures of the rock masses of the earth's crust, and the forces which modify them. A brief review of historical geology deals with the fossil life of the globe. Practice in Field Geology teaches the methods by which rock formations are accurately mapped. Economic Geology treats of the origin, mode of occurrence and distribution of the metallic and non-metallic minerals and substances of commercial value in the earth. The course in Petrography enables the student to identify the common rock-forming minerals by the use of the microscope, especially when the constituents are too fine-grained to be determined by the eye alone. Practice in the petrographic and geological laboratory and in the field qualifies the student to recognize the main types of rocks.

Physiography treats of the classification of land forms and their geographical distribution, their relation to geologic structure, weather and climate, and their influence upon the economic development of countries. The course in Geology of North America discusses the geologic ages and the geographic distribution of the rocks of the continent, their structure and history, and includes studies of the great surveys that have been made. Paleontology reviews the life of past ages and in-

volves the study and identification of fossils as a means of determining the age of rocks by the principles of stratigraphy.

The course in Heat Engines includes a practical study of boilers, steam and gas engines and steam turbines; work in the Wilbur Engineering Laboratory includes tests and calculations of efficiencies and powers under varying conditions.

Strength of Materials treats of the theories which govern the strength of all kinds of common materials used in construction. Practice is given in computing and designing beams, columns, girders, etc. Hydraulics deals with the flow of liquids through orifices, mains, pipes and channels, and with the principles of hydraulic motors; practical work in the Fritz Engineering Laboratory is a part of this course. Graphic Statics qualifies the student to compute the forces developed in roof trusses, bridges and girders by the methods of graphical analysis.

The instruction in Mining Engineering is given during the Junior and Senior years, under the following subdivisions: prospecting, boring, mining or exploitation, haulage, hoisting, drainage, ventilation, lighting, first-aid, railroads, construction materials and mine administration. These subjects treat successively of the steps by which minerals are discovered and valued, the manner in which they are extracted from the earth and brought to the surface, the manner in which accidents may occur and means for guarding against them, and the treatment of injured persons, and the means by which mines are maintained in an economical condition from the viewpoint of mine owner and miner.

The subject of Ore Dressing, supplemented by work in the Coxe Mining Laboratory, deals with the processes by which ores and fuels, direct from the mine, are rendered marketable. Construction Materials treats of the materials used in roads and structures in and around mines. Mine Administration discusses the method of employing labor and of keeping accounts, mining principles and management.

The course in Oil and Gas Technology includes a study of the occurrence and distribution of petroleum and natural gas, the methods of prospecting, the means for obtaining them from the earth, and their storage and transportation.

In Mining Design the student employs principles studied and observations made as the basis for designs and working drawings of parts of mining plant to fulfill given conditions.

In Metallurgy the general principles of the subject embracing fuels, furnaces and processes, are presented, followed by the metallurgy of iron and steel, copper, lead, gold, silver, zinc, tin, mercury, nickel and aluminium. Electrochemistry and Electrometallurgy familiarize the student with the practical applications of electricity to metallurgical processes including electric-furnace practice.

Dynamos and Motors and Alternating Currents extend over the entire Senior year and embrace the study of the industrial applications of electricity which are of particular value to the mining engineer; practical work in the Dynamo Laboratory is included in these courses.

It may thus be observed that the student of the Course in Mining Engineering has studies in all of the technical departments of the University, as well as in many of the arts and science departments.

The facilities for exemplifying the work of the course are exceptional. Cement mills, cement, slate and other quarries, ore and coal mines are within easy distance, and in the city are the great works of the Bethlehem Steel Company. During the Junior and Senior years all students in Mining Engineering are required to make inspection trips to the anthracite coal regions and to the metal mining districts of eastern Pennsylvania and of New Jersey and to the metallurgical works of those districts.

The Department of Mining Engineering has exceptional facilities in the Eckley B. Coxe Mining Laboratory. A description of the Laboratory is given on pages 152-153 of this Register.

Graduates of this course receive the degree of Engineer of Mines (E.M.).

THE COURSE IN MINING ENGINEERING

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T
Adv. Algebra	143	(4)	4	8	12
Chemistry	390	(2)	2	4	6
Chem. Lab.	391	(2)	6	0	6
El. Mechanics	320	(3)	3	5	8
French 94 / or German 75 / or Spanish 111		(3)	3	6	9
English	120	(2)	2	2	4
M.S. & P.E.	470, 500	(2)	4	2	6

SECOND TERM	N	C	R	P	T
P. Anal. Geom.	145	(3)	3	6	9
Qual. Anal.	395	(3)	9	0	9
Stoichiometry	397	(1)	1	2	3
El. Mechanics	321	(3)	3	4	7
Phys. Measure	322	(1)	3	2	5
French 94 / or German 75 / or Spanish 111		(3)	3	5	8
Drawing	300	(2)	4	0	4
M.S. & P.E.	470, 500	(2)	4	2	6

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3)

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T
Cal. & S.A.Geom.	146	(4)	4	8	12
Quant. Anal.	401	(3)	9	0	9
Quant. An. Conf.	402	(1)	1	1	2
Elec. & Mag.	323	(3)	3	4	7
M. & H. Lab.	324	(1)	2	1	3
Mineralogy	266	(4)	6	3	9
B. P. Anal.	267	(1)	3	0	3
Drawing	300	(1)	3	0	3
M.S. & P.E.	471, 500	(2)	4	2	6

SECOND TERM	N	C	R	P	T
Int. Calculus	147	(4)	4	8	12
Quant. Anal.	403	(3)	9	0	9
Quant. An. Conf.	405	(1)	1	1	2
Light & Sound	325	(3)	3	4	7
L., E. & M. Lab.	326	(1)	2	1	3
Gen. Geology	268	(2)	2	3	5
Geol. Lab.	269	(2)	4	3	7
B. P. Anal.	267	(1)	3	0	3
M.S. & P.E.	471, 500	(2)	4	2	6

SUMMER TERM: Land and Topographic Surveying, 165, 3 weeks (3)

JUNIOR YEAR

FIRST TERM	N	C	R	P	T
Mining Engr.	301	(4)	4	4	8
Ore Dr. & Lab.	302	(3)	3	3	6
Str. of Mat.	167	(4)	4	8	12
Heat Eng.	221	(3)	3	6	9
Petrography	276	(2)	3	2	5
Econ. Geol.	270	(2)	2	3	5
Forestry	291	(2)	3	2	5
Physical Ed.	500	(1)	2	0	2

SECOND TERM	N	C	R	P	T
Mining Engr.	303	(4)	4	4	8
Metallurgy	247	(3)	3	4	7
Heat Eng.	222	(3)	3	6	9
Hydraulics	170	(3)	3	6	9
Hyd. Lab.	171	(1)	3	0	3
Physiography	274	(2)	2	2	4
Oil & Gas Tech.	306	(2)	2	2	4
English	127	(2)	2	4	6
Physical Ed.	500	(1)	2	0	2

SUMMER TERM: Assaying, 413, 4 weeks (3); Mine and Railroad Surveying, 304, 3 weeks (3)

SENIOR YEAR

FIRST TERM	N	C	R	P	T
Mining Engr.	305	(3)	3	3	6
N. F. Met.	248	(2)	2	2	4
El. Chem. & Met.	254	(2)	2	3	5
Dyn. & Mot.	354	(2)	2	4	6
Dyn. Lab.	355	(1)	3	1	4
Field Geol.	275	(3)	7	3	10
Graph. Stat.	178	(2)	4	2	6
Engr. Lab.	220	(1)	3	0	3
Bus. Engr.	30a	(3)	3	3	6
Physical Ed.	500	(1)	2	0	2

SECOND TERM	N	C	R	P	T
Mining Des.	307	(3)	6	1	7
Econ. Geol.	271	(4)	5	5	10
N. F. Met.	250	(2)	2	2	4
Alt. Cur.	375	(2)	2	4	6
Dyn. Lab.	356	(1)	3	1	4
Geol. N. A.	273	(3)	5	2	7
Engr. Lab.	226	(1)	3	0	3
Mine Ad.	305	(1)	1	2	3
Bus. Engr.	30a	(3)	3	3	6
Physical Ed.	500	(1)	2	0	2

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

THE COURSE IN ELECTRICAL ENGINEERING

The requirements for admission to the Course in Electrical Engineering are given on page 20.

The object of this course is to give a broad education in those general and scientific subjects which underlie all the branches of engineering, and to give special training in those technical and business subjects which experience shows are most essential in the equipment of the electrical engineer. In seeking to accomplish this object the Department puts chief emphasis upon mastery of principles and thoroughness in the analysis of problems.

The course includes a number of special studies in civil, mechanical and metallurgical engineering, so that the graduate in Electrical Engineering is prepared not only to enter any of the branches of electrical engineering but also to deal with related problems in the other branches of engineering. The electrical engineering graduate of today finds that professional advancement often lies through commercial, managerial or executive channels. As superintendent or manager of electric light, power or railway properties he must be prepared to handle problems involving not merely material and technical details but human relations, touching workmen, capitalists, public utility commissioners, and the public. He must know something of the principles of accounting, economics, business law and industrial management. A number of such studies have been introduced into the course.

The fundamental studies are given in the early part of the course and include mathematics, physics, chemistry, English and that modern language accepted for entrance. These subjects include the more essential features of a broad education and they furnish a preparation for the more advanced scientific and technical training to follow.

Work in applied electricity is pursued through the Sophomore year in the study of Electric Distribution, and Dynamos and Motors, with Dynamo Laboratory. The Junior and Senior years are devoted almost exclusively to advanced technical work.

The study of Electricity and Magnetism constitutes an introduction to the industrial applications of electricity. Electric Distribution makes immediate application of electrical theory to the calculation of lighting and power circuits, the testing of insulation resistance and similar problems. The study also includes the installation and wiring of electrical machinery, systems of electrical distribution, outside and interior wiring.

The study of Dynamos and Motors includes the construction, operation and control of direct current generators and motors, with numerous illustrative problems. The study of dynamo electric machinery is resumed during the Senior year in connection with the subjects Electrical Design and Alternating Current Machinery.

Fundamental subjects in mechanical engineering are required in this course. Machine Design is given throughout the Sophomore year. Frequent visits of inspection are made to manufacturing establishments in the vicinity. Work in electrical shops or construction is required at the end of the Sophomore and Junior years. Graphic Statics of Mechanisms deals with graphic methods of determining the forces acting at all points of a machine and with the efficiency of mechanisms. Heat Engines includes the study of steam boilers, thermodynamics, steam engines, turbines, and gas engines. Engineering Laboratory is given throughout the Senior year.

Important studies in Civil Engineering are included in this course. Strength of Materials is concerned with the theory of beams, columns and shafts, and the method of computing and designing them; the subject includes practical work in the testing laboratory. Hydraulics, including laboratory practice, treats of hydrostatics and theoretical hydraulics, the flow of water through orifices, weirs, pipes and channels, naval hydromechanics and hydraulic motors.

The study of General Metallurgy, Metallurgy of Iron and Steel and Metallurgical Problems is given during the first term of the Sophomore year. Lectures on Electrochemistry and Electrometallurgy are given during the Senior year.

Advanced studies in Electrical Engineering follow Electric Distribution, Dynamos and Motors, and Electricity and Magnetism of the Sophomore year. Advanced Theory of Electricity and Magnetism is devoted to the theory of electrical units and measurements, ferromagnetism, electromagnetism, and ad-

vanced theory of electrostatics, electric oscillations and waves, electron theory and electrolysis. The accompanying laboratory work is devoted to precise electrical measurements and the standardization and calibration of electrical measuring instruments. The Theory of Alternating Currents deals with the problems and methods of measurements which are peculiar to the modern practical applications of alternating currents and with the theory underlying the action of the important types of alternating current machinery and transmission lines. Alternating Current Machinery includes the study of the construction and operation of alternating current generators, motors, transformers and other apparatus.

The subject of Electrical Engineering deals with the application of physical principles to the solution of problems relating to direct and alternating current circuits and apparatus.

Dynamo laboratory work, beginning in the second term of the Sophomore year, is continued for five terms. Instruction is based on a laboratory manual or notes supplemented by individual direction and supervision in the laboratory. The students work individually or in pairs, and make the more important tests on direct and alternating current generators and motors, rotary converters, transformers and other electrical apparatus. Written reports of all tests made, with curves plotted from the observations and discussion of results, are required.

Electrical Design, begun in the first term of the Senior year, is pursued throughout the year. It includes the application of electric, magnetic and mechanical principles to the design of various types of electrical apparatus. The instruction is given by recitations, problems and drafting.

Electrical Engineering Seminary continues throughout the Senior year. The work consists of the presentation before the class of papers on assigned topics, supplementing the regular work of the class-room and of reports on thesis work. The Department reading-room is well supplied with the leading electrical periodicals, American and foreign. One of the principal objects of the Seminary work is to encourage the systematic reading of the current engineering journals.

Dynamo Testing, given by lectures and problems, treats of standard and special methods of making tests on dynamo machines, transformers and other electrical apparatus.

Electric Stations takes up the location, design and equipment of stations, the selection of suitable prime movers, generators, switchboards and other apparatus. The use and operation of storage batteries, boosters and other auxiliaries receive consideration. Under Electric Traction are studied the construction, equipment and operation of different types of electric railways. The recent developments in the application of electric motive power to steam railroad conditions are discussed and the results of tests are analyzed.

The subject of Electric Power Transmission deals with the various elements constituting a transmission system. It includes a study of the generating plant, the transmission line and the receiving systems. Special attention is given to the design, construction and protection of the line. Under the last three subjects are included visits of inspection to electric light and power stations and manufacturing establishments in Bethlehem and elsewhere. Central station tests are made and reports are required.

Graduates of this course receive the degree of Electrical Engineer (E.E.).

THE COURSE IN ELECTRICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T
Adv. Algebra	143	(4)	4	8	12
Chemistry	390	(2)	2	4	6
Chem. Lab.	391	(2)	6	0	6
El. Mechanics	320	(3)	3	5	8
French / or German / or Spanish	94 / 75 / 111	(3)	3	6	9
English	120	(2)	2	2	4
M.S. & P.E.	470, 500	(2)	4	2	6

SECOND TERM	N	C	R	P	T
P. Anal. Geom.	145	(3)	3	6	9
Qual. Anal.	395	(3)	9	0	9
Stoichiometry	397	(1)	1	2	3
El. Mechanics	321	(3)	3	4	7
Phys. Measure.	322	(1)	3	2	5
French / or German / or Spanish	94 / 75 / 111	(3)	3	5	8
English	122	(2)	2	2	4
M.S. & P.E.	470, 500	(2)	4	2	6

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3)

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T
Cal. & S.A.Geom.	146	(4)	4	8	12
Elec. & Mag.	323	(3)	3	4	7
M. & H. Lab.	324	(1)	2	1	3
Elec. Distribution.	351	(2)	2	6	8
Dr. & El. M. Des.	200	(3)	6	3	9
Metallurgy	247	(3)	3	4	7
M.S. & P.E.	471, 500	(2)	4	2	6

SECOND TERM	N	C	R	P	T
Int. Calculus.	147	(4)	4	8	12
Light & Sound.	325	(3)	3	4	7
L., E. & M. Lab.	326	(1)	2	1	3
Dyn. & Mot.	352	(3)	3	6	9
Dyn. Lab.	353	(1)	3	1	4
El. Mach. Des.	203	(3)	3	6	9
Gr.St. of Mech.	206	(2)	4	0	4
M.S. & P.E.	471, 500	(2)	4	2	6

SUMMER TERM: Work in Electrical Shops or Plants, with report, 8 weeks (3)

JUNIOR YEAR

FIRST TERM	N	C	R	P	T
Diff. Equations	148	(1)	1	3	4
Anal. Mech.	149	(2)	2	4	6
Alt. Currents	357	(3)	3	4	7
Dyn. Lab.	358	(1)	3	0	3
Elec. Lab.	329	(1)	3	0	3
Adv.Elec. & Mag.	328	(2)	2	4	6
Str. of Mat.	167a	(3)	3	6	9
Str. Mat. Lab.	168	(1)	3	0	3
Heat Eng.	221	(3)	3	6	9
Physical Ed.	500	(1)	2	0	2

SECOND TERM	N	C	R	P	T
Alt. Cur.	359	(2)	2	4	6
Elec. Engr.	360	(3)	3	6	9
Dyn. Test.	364	(1)	3	0	3
Dyn. Lab.	362	(1)	3	1	4
Elec. Lab.	330	(1)	3	1	4
Hydraulics	170a	(2)	2	4	6
Hyd. Lab.	171	(1)	3	0	3
Heat Eng.	222	(3)	3	6	9
English	127	(3)	3	3	6
Physical Ed.	500	(1)	2	0	2

SUMMER TERM: Work in Electrical Shops or Plants, with report, 8 weeks, 376 (3)

SENIOR YEAR

FIRST TERM	N	C	R	P	T
Alt. Cur. Mach.	363	(4)	4	6	10
Dyn. Testing	365	(1)	1	1	2
Dyn. Lab.	366	(3)	6	3	9
Elec. Design	367	(2)	3	3	6
Elec. Stations	368	(2)	2	4	6
El. Chem. & Met.	254	(2)	2	3	5
Engr. Lab.	220	(1)	3	0	3
Elec. Seminary.	369	(1)	2	1	3
Bus. Engr.	30a	(3)	3	3	6
Physical Ed.	500	(1)	2	0	2

SECOND TERM	N	C	R	P	T
Elec. Traction / or Elec. Com.	371 / 378	(3)	3	5	8
Elec. Power Tr.	372	(3)	3	5	8
Elec. Design.	370	(2)	2	3	5
Dyn. Lab.	374	(2)	6	2	8
Elec. Seminary	373	(1)	2	1	3
Engr. Lab.	226	(1)	3	0	3
Bus. Engr.	30a	(3)	3	3	6
Thesis	377	(3)	8	1	9
Physical Ed.	500	(1)	2	0	2

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

THE COURSE IN CHEMISTRY

The requirements for admission to the Course in Chemistry are given on page 20.

This course, leading to the degree of Bachelor of Science in Chemistry, offers an education primarily in chemistry, with some training in related sciences. The modern conception of an education in chemistry includes a simultaneous, thorough study of physics and mathematics. In addition to these so-called physical sciences, other studies, planned to develop and aid the thought-processes and culture of the student, are embodied in the course. Aside from preparation for the life of a professional chemist, it is well adapted for teachers of chemistry and as a course preliminary to the study of medicine.

This course and the Course in Chemical Engineering are both given under the direction of the Department of Chemistry, and facility is offered for changing from either course to the other at the end of either term of the Freshman year. The entrance subjects required are the same in both courses (see page 20), and the tuition and laboratory costs are practically the same. Subjects with the same title in the tabulated curricula (see pages 67 and 72) are given to students in both courses simultaneously and under the same teachers, and are equal in content. Details of chemistry subjects are described in the course in Chemical Engineering.

French and German receive considerably more attention in the course in Chemistry, both as language tools for the working chemist and in their cultural aspects. Students who enter the University on French continue French through the Freshman year, and take up German through the Sophomore and Junior years. Those who offer German as an entrance subject continue German through the Freshman and Sophomore years and study French through the Junior year. Students who offer Spanish for entrance take German through the Freshman and Sophomore years, and French through the Junior year.

The course in Bacteriology of the Senior year is given in the Department of Biology. A short course in Industrial Mineralogy accompanies the course in Assaying. Geology follows in the second term of the Junior year.

Economics throughout the Junior year and Modern European History through the Senior year are given by the Depart-

ment of History and Economics. The same department supervises the Summer Reading in Economics, embracing such subjects as origins of industry and their relations to science, the economic import of inventions, industrial management, business law and custom and contracts. The topics for Summer Reading are also correlated in the lectures under the heading Economics, mentioned above. It is believed that this course of reading and study under expert guidance will inculcate an appreciation of the profit and pleasure to be derived from a continued interest in history and economics.

In order to acquaint the student with factory methods and personnel, a required summer term of work in factory or laboratory is set for the vacation following the Junior year. Young men of exceptional ability and ambition are encouraged to enroll in subjects given in the University not listed in the Course in Chemistry, subject to Faculty rules.

The foregoing course will serve as an excellent preparation for graduate study; students who desire to go forward to the Master's Degree (M.S.) will find information on page 133 of this Register.

THE COURSE IN CHEMISTRY

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T
Adv. Algebra	143	(4)	4	8	12
Chemistry	390	(2)	2	4	6
Chem. Lab.	391	(2)	6	0	6
El. Mechanics	320	(3)	3	5	8
French or German	94, 72 or 76	(3)	3	6	9
English	120	(2)	2	2	4
M.S. & P.E.	470, 500	(2)	4	2	6

SECOND TERM	N	C	R	P	T
P. Anal. Geom.	145	(3)	3	6	9
Chemistry	394	(1)	1	1	2
Qual. Anal.	395	(3)	9	0	9
Qual. An. Conf.	396	(1)	1	1	2
Stoichiometry	397	(1)	1	2	3
El. Mechanics	321	(3)	3	4	7
Phys. Measure	322	(1)	3	2	5
French or German	94, 72 or 76	(3)	3	5	8
M.S. & P.E.	470, 500	(2)	4	2	6

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3); Summer reading in Economics, 30 (1)

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T
Cal. & S.A.Geom.	146	(4)	4	8	12
Adv. Chem.	398	(3)	3	3	6
Quant. Anal.	400	(3)	9	0	9
Quant. An. Conf.	402	(1)	1	2	3
Elec. & Mag.	323	(3)	3	4	7
M. & H. Lab.	324	(1)	2	1	3
German	72, 76 or 78	(3)	3	5	8
M.S. & P.E.	471, 500	(2)	4	2	6

SECOND TERM	N	C	R	P	T
Int. Calculus	147	(4)	4	8	12
Adv. Chem.	399	(3)	3	6	9
Quant. Anal.	404	(2)	6	0	6
Quant. An. Conf.	405	(2)	2	1	3
Light & Sound.	325	(3)	3	4	7
L., E. & M. Lab.	326	(1)	2	1	3
German	72, 76 or 79	(3)	3	5	8
M.S. & P.E.	471, 500	(2)	4	2	6

SUMMER TERM: Assaying and Industrial Mineralogy, 4 weeks, 414 (3); Summer reading in Economics, 30 (1)

JUNIOR YEAR

FIRST TERM	N	C	R	P	T
Quant. Anal.	406	(2)	6	0	6
Quant. An. Conf.	407	(2)	2	2	4
Org. Chem.	408	(3)	3	3	6
Org. Chem. Lab.	409	(2)	6	0	6
G.Met.&Probs.	243, 244	(3)	3	4	7
Economics	16	(3)	3	3	6
French or German	90, 76 or 78	(3)	3	5	8
English	123	(3)	3	4	7
Physical Ed.	500	(1)	2	0	2

SECOND TERM	N	C	R	P	T
Org. Chem.	410	(5)	5	3	8
Org. Chem. Lab.	411	(3)	9	0	9
I.& S.& Probs.	245, 246	(3)	3	4	7
Gen. Geol.	268	(2)	2	3	5
Economics	17	(3)	3	3	6
French or German	90, 76 or 79	(3)	3	5	8
English	127	(3)	3	4	7
Physical Ed.	500	(1)	2	0	2

SUMMER TERM: Work in Industrial Shop or Laboratory (3); Summer Reading in Economics, 30 (1)

SENIOR YEAR

FIRST TERM	N	C	R	P	T
Phys. Chem.	419	(3)	3	3	6
Phys. Chem. Lab.	420	(1)	3	0	3
Ind. Chem. Lab.	412	(3)	9	2	11
Research Chem.	423	(3)	3	6	9
N.F.Met.&Prob.	248, 249	(3)	3	4	7
Bacteriology	296	(2)	3	3	6
El. Chem.	252	(1)	1	2	3
History	41	(3)	3	3	6
Physical Ed.	500	(1)	2	0	2

SECOND TERM	N	C	R	P	T
Phys. Chem.	421	(2)	2	3	5
Phys. Chem. Lab.	422	(1)	3	0	3
Ind. Chem.	415	(3)	3	3	6
Research Lab.	424	(2)	6	0	6
Ind. Chem. An.	416	(3)	9	0	9
Ind. An. Conf.	417	(1)	1	1	2
San. Chem. Lab.	418	(1)	3	0	3
N. F. Met.	250	(2)	2	2	4
El. Met.	253	(1)	1	2	3
Hist. of Chem.	425	(1)	1	1	2
History	42	(3)	3	3	6
Physical Ed.	500	(1)	2	0	2

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

THE COURSE IN CHEMICAL ENGINEERING

The requirements for admission to the Course in Chemical Engineering are given on page 20.

This course of study is designed to prepare the student for the profession of chemical engineering in the construction, control and management of manufacturing establishments which utilize principles of chemistry and its allied arts. Aside from the primary requirement of chemistry, the modern development of the chemical engineer enforces a thorough knowledge of physics and mathematics, together with sound understanding of such fundamentals in mechanical and electrical engineering as will make him a discriminating research and operating engineer.

Elementary Chemistry, begun in the Freshman year, in lectures with demonstrations, text-books and recitations, is supplemented by experiments in the laboratory which develop manipulative skill and make careful observation habitual. An alternate course, less elementary in both class-room and laboratory, is given to entering students who have had a considerable training in elementary chemistry. (See page 28.)

After this preliminary view of the elements of chemistry, there is developed that deeper insight into the changes of matter which is the particular province of general chemistry. In Advanced Chemistry of the first term in the Sophomore year particular attention is paid to the theories and modern concepts of chemistry, including solution, equilibrium and energy relations of molecules and of atoms, radio-activity, etc.,—a kind of junior physical-chemistry of the greatest, everyday importance in chemical engineering. Continued through the second term, this subject covers a moderately advanced study of chemical substances, their preparation and properties, together with elementary consideration of phase rule and of such general applications as the relations underlying desirable properties in alloys, iron and steel, etc.

Organic Chemistry, taught during the entire Junior year, familiarizes the student with the simpler compounds of carbon, and acquaints him with the usefulness of this branch of chemistry in science, in the chemistry of animal and plant life, and in the manufacture of such chemical products as dyes, drugs and medicines, oils, fats, waxes, and many others.

Introduction to the chemical analysis of substances is begun through Qualitative Analysis in the second term of the Freshman year. This is a laboratory course, proceeding from the recognition of individual substances to the analysis of more complex solutions and solids. Lectures and recitations elucidate the facts and theories underlying analytical chemistry. The simpler mathematical relations of chemical processes are reviewed under Stoichiometry and are illustrated through many problems solved by the student. Quantitative Chemical Analysis by gravimetric, volumetric and electrolytic methods follows through the Sophomore year and the first term of the Junior year, and takes up the analysis of ores, fuels, metallurgical products, commercial chemicals and by-products. Frequent class-room conferences accompany the laboratory work and elucidate the calculations involved and the scientific foundations of quantitative analysis. The analysis of industrial organic substances and of food-stuffs, drinking and boiler waters is placed in the final term of the Senior year, when the student has a better foundation in increasing experience and a broader outlook toward the important significance of Industrial Chemistry. At this stage, too, is placed the sampling and analysis of illuminating and heating gas, flue gases and other special gases.

Fire-assaying of ores and of gold and silver bullion is taught in the summer term after the Sophomore year when continuous attention throughout the day can be given to muffles and furnaces. The practice in Assaying is accompanied by extensive consideration of the calculations and theories involved in the production of mixtures favorable for the work in hand. A course in Industrial Mineralogy is a part of this summer work, and leads to familiarity with about seventy-five minerals of commercial importance. These minerals are studied in their crystalline forms, also in the forms in which they often present themselves for final utilization by the chemical engineer.

The laboratory methods of Physical Chemistry and the systematic, deeper study of generalizations of chemistry learned in the Sophomore year are reserved for the Senior year under Physical Chemistry. Interrelations of the fundamentals of matter and energy are developed under such cognate headings as two-phase and multiphase systems, thermodynamics, gas reactions, mass action, electrochemistry, colloid chemistry,

etc. Attention is given to the usefulness of Physical Chemistry in the solution of manufacturing problems in Chemical Engineering.

Intensive instruction in the application of factory methods in Chemical Engineering is likewise placed in the Senior year and is grouped under Industrial Chemistry Laboratory and Industrial Chemistry. The processes reviewed are varied; such as transportation of gases, liquids and solids; grinding, pulverizing; mechanical, hydraulic and pneumatic separation; evaporation; distillation; filter pressing; centrifuging; autoclaving. Characteristics and adaptability of engineering materials used in apparatus and machines receive full discussion. Selected industries are investigated and explained. Familiarity with manufacture in its scientific and economic aspects is promoted in the special laboratory fitted with industrial apparatus, the student finally submitting full working specifications for a plant designed for the preparation of some industrial product, together with estimates of cost of raw materials and cost of conversion into finished product. Lehigh University is fortunately situated in a district abounding in business enterprises which involve chemical engineering and visits are made to these plants and to factories in the nearby cities of Philadelphia and New York.

In Research Chemistry of the Senior year every student is required to solve a novel problem having a scientific basis and is expected to demonstrate some ability as an independent research worker. A short course in History of Chemistry, with individual reading of significant records, co-ordinates the past progress of the science and leads to a nobler pride and an enhanced initiative in the profession which the graduate enters.

Metallurgy and related subjects are taken in the Department of Metallurgy. Drawing is under the direction of the Department of Mining Engineering. Instruction in mechanical engineering, so important to the chemical engineer, is given by the Mechanical Engineering Department. Mechanical Engineering is developed in Heat Engines of the Junior year, and in the Engineering Laboratory of the summer term following the Junior year, with a continuation of Engineering Laboratory in the Senior year. Many of the problems and innovations of Chemical Engineering demand a more intimate knowledge of the principles and practice of Electrical Engineering than is

given in the general course in Physics; this is provided for in the Junior year under Dynamos and Motors and Alternating Currents, with their laboratory adjuncts, of the Department of Electrical Engineering. A comprehension of the scope and general methods of Geology and Bacteriology is attained in short courses in these subjects. Bacteriology is a lecture and laboratory course, and a working knowledge of bacteriological methods as applied to water and some industrial products is achieved.

In addition to the usual courses in English of the beginning years, a course in English is provided for the Senior year, by which time, it is hoped, the student will have a mature appreciation of literary values. The study of German, a necessary tool in current chemistry, is carried by all students in the Freshman year.

An approach to the affairs of men and the problems of business and civilization is carried in some period of all four years, and is under the direction of the Head of the College of Business Administration. The full course of lectures in Economics as given in the University is placed in the Junior year. Related reading is specified as summer work, and examination in this requirement is held on the first Saturday following the opening of the first term. Summer reading comprises such matter as origins of industry and their relation to science, industrial management, business law and custom and contracts.

A scientific society is attached to the Department, with a membership of teachers and students, for the presentation of papers, discussion of current journals, and the entertainment of speakers of note in the profession of chemical engineering.

The degree granted on completion of the course is Chemical Engineer (Ch.E.).

THE COURSE IN CHEMICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Adv. Algebra	143	(4)	4	8	12	P. Anal. Geom.	145	(3)	3	6	9
Chemistry	390	(2)	2	4	6	Chemistry	394	(1)	1	1	2
Chem. Lab.	391	(2)	6	0	6	Qual. Anal.	395	(3)	9	0	9
El. Mechanics.	320	(3)	3	5	8	Qual. An. Conf.	396	(1)	1	1	2
German	72 or 76	(3)	3	6	9	Stoichiometry	397	(1)	1	2	3
English	120	(2)	2	2	4	El. Mechanics.	321	(3)	3	4	7
M.S. & P.E.	470, 500	(2)	4	2	6	Phys. Measure.	322	(1)	3	2	5
						German	72 or 76	(3)	3	5	8
						M.S. & P.E.	470, 500	(2)	4	2	6

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3)
Summer reading in Economics, 30 (1)

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Cal. & S.A.Geom.	146	(4)	4	8	12	Int. Calculus	147	(4)	4	8	12
Adv. Chem.	398	(3)	3	3	6	Adv. Chem.	399	(3)	3	6	9
Quant. Anal.	400	(3)	9	0	9	Quant. Anal.	404	(3)	9	0	9
Quant. An. Con.	402	(2)	2	2	4	Quant. An. Conf.	405	(2)	2	3	5
Elec. & Mag.	323	(3)	3	4	7	Light & Sound.	325	(3)	3	4	7
M. & H. Lab.	324	(1)	2	1	3	L., E. & M. Lab.	326	(1)	2	1	3
Drawing	300	(1)	3	0	3	Drawing	300	(1)	3	0	3
English or German	123 or 73	(2)	2	2	4	M.S. & P.E.	471, 500	(2)	4	2	6
M.S. & P.E.	471, 500	(2)	4	2	6						

SUMMER TERM: Assaying and Industrial Mineralogy, 4 weeks, 414 (3);
Summer Reading in Economics, 30 (1)

JUNIOR YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Quant. Anal.	406	(2)	6	0	6	Org. Chem.	410	(5)	5	4	9
Quant. An. Conf.	407	(1)	1	1	2	Org. Chem. Lab.	411	(3)	9	0	9
Org. Chem.	408	(3)	3	2	5	I.& S.& Probs.	245, 246	(3)	3	4	7
Org. Chem. Lab.	409	(2)	5	0	5	Alt. Cur.	375	(2)	2	4	6
Dyn. & Mot.	354	(2)	2	4	6	Dyn. Lab.	356	(1)	3	1	4
Dyn. Lab.	355	(1)	3	1	4	Heat Eng.	224	(3)	3	6	9
G.Met.&Probs.	243, 244	(3)	3	4	7	Economics	17	(3)	3	3	6
Heat Eng.	223	(3)	3	6	9	Physical Ed.	500	(1)	2	0	2
Economics	16	(3)	3	3	6						
Physical Ed.	500	(1)	2	0	2						

SUMMER TERM: Engineering Laboratory, 4 weeks, 225 (3);
Summer Reading in Economics, 30 (1)

SENIOR YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Phys. Chem.	419	(3)	3	3	6	Phys. Chem.	421	(2)	2	3	5
Phys. Chem. Lab.	420	(1)	3	0	3	Phys. Chem. Lab.	422	(1)	3	0	3
Ind. Chem. Lab.	412	(3)	9	2	11	Ind. Chem.	415	(3)	3	3	6
Research Chem.	423	(2)	2	4	6	Research Lab.	424	(2)	5	0	5
N.F.Met.&Prob.	248, 249	(3)	3	4	7	Ind. Chem. Anal.	416	(3)	9	0	9
Engr. Lab.	220	(1)	3	0	3	Ind. An. Conf.	417	(1)	1	1	2
Bacteriology	296	(2)	3	3	6	San. Chem. Lab.	418	(1)	3	0	3
El. Chem.	252	(1)	1	2	3	Hist. of Chem.	425	(1)	1	1	2
El. Chem. Lab.	255	(1)	2	1	3	N. F. Met.	250	(2)	2	2	4
English	137	(1)	2	0	2	El. Met.	253	(1)	1	2	3
Physical Ed.	500	(1)	2	0	2	Engr. Lab.	226	(1)	3	0	3
						Gen. Geol.	268	(2)	2	3	5
						Physical Ed.	500	(1)	2	0	2

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

THE COURSE IN SHIP CONSTRUCTION AND MARINE TRANSPORTATION

The requirements for admission to the Course in Ship Construction and Marine Transportation are given on page 20.

The purpose of this course is to prepare men to engage in the design, construction and operation of ships, and to enter the field of marine transportation. The course is a combination of engineering and economics preceded by the fundamental subjects common to engineering courses: chemistry, modern languages, physics and mathematics. Combining, as it does, engineering training with studies in economics and business administration, such a course offers great advantages. It has been planned to develop a class of men, who in addition to a knowledge of conditions governing ocean and inland water transportation, will have a command of the technical, economic, and financial problems of ship design, construction and operation.

The first and second years are devoted largely to physics, modern languages, chemistry, engineering drawing, and mathematics, all of which afford necessary preparation for the technical work in later years.

The second year schedule, although largely concerned with science, embraces some preliminary work in engineering and economics. There is a detailed study of ship construction, including lectures and class room work covering the main features of ship construction, and also work in the drawing room where drawings of ship construction are worked up by the student. In the second term the student fairs up a set of ship's lines. Both the transverse and longitudinal types of construction are given full treatment in this course.

The Junior year schedule includes these fundamental engineering subjects: Strength of Materials, Hydraulics, Naval Architecture, Steam Engineering, Marine Engineering, and Astronomy and Navigation. Class room work in most of the subjects is supplemented by exercises in the laboratories. In the first term of the third year a study is made of the theory of heat engineering and thermodynamics. This course is followed in the second term by a study of marine engineering with special emphasis on the types of propelling machinery,

layout of the marine power plant and economic problems in marine engineering.

In the Senior year the student takes up the study of Ship Design, Marine Engines and Turbines, Structural Steel Design, Electrical Engineering, Economics, and Marine Transportation. For those who desire further work in foreign languages, an opportunity is given in the Senior year for the study of Spanish.

An important feature of the Lehigh Course in Ship Construction and Marine Transportation is the large amount of time devoted to the study of economics and allied subjects. To arouse the student's interest and to fit him for work in marine transportation and foreign trade, instruction in Economics and Economic Geography is given in the Sophomore year, followed by Marine Insurance, Foreign Exchange and Finance in the Junior year, and by Foreign Trade and Admiralty Law in the Senior year.

Surveying is given during four weeks of the summer term immediately following the close of the Freshman year.

Students are required to do summer work in shipyards and on shipboard, and the department co-operates in finding positions for them. The summer following the Sophomore year is spent in a shipyard. This brings the student into direct contact with practical ship construction and shipyard practices, so that he unconsciously acquires a knowledge of proportions and dimensions of engineering structures. The summer following the Junior year is spent at sea so that the student may observe the action of a ship at sea, and study the operation of the ship's power plant.

A pamphlet, giving further details, may be obtained by addressing the Registrar.

Graduates of this course receive the degree of Naval Engineer (N.E.).

THE COURSE IN SHIP CONSTRUCTION AND MARINE TRANSPORTATION

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T
Adv. Algebra	143	(4)	4	8	12
Chemistry	390	(2)	2	4	6
Chem. Lab.	391	(2)	6	0	6
El. Mechanics	320	(3)	3	5	8
French / or German / or Spanish	94 / 75 / 111	(3)	3	6	9
English	120	(2)	2	2	4
M.S. & P.E.	470, 500	(2)	4	2	6

SECOND TERM	N	C	R	P	T
P. Anal. Geom.	145	(2)	6	0	6
Qual. Anal.	395	(2)	6	0	6
Stoichiometry	397	(1)	1	2	3
El. Mechanics	321	(3)	3	4	7
Phys. Measure	322	(1)	3	2	5
French / or German / or Spanish	94 / 75 / 111	(3)	3	5	8
English	122	(2)	2	2	4
Drawing	162	(1)	3	0	3
M.S. & P.E.	470, 500	(2)	4	2	6

SUMMER TERM: Land and Topographic Surveying, 165, 3 weeks (3)

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T
Cal. & S.A.Geom.	146	(4)	4	8	12
Elec. & Mag.	323	(3)	3	4	7
M. & H. Lab.	324	(1)	2	1	3
Metallurgy	247	(3)	3	4	7
Engr. Drawing	163	(3)	7	1	8
Ship Constr.	450	(2)	4	1	5
Economics	16	(3)	3	3	6
M.S. & P.E.	471, 500	(2)	4	2	6

SECOND TERM	N	C	R	P	T
Int. Calculus	147	(4)	4	8	12
Light & Sound	325	(3)	3	4	7
L., E. & M. Lab.	326	(1)	2	1	3
Econ. Geog.	35	(3)	3	6	9
Ship Constr.	451	(4)	9	2	11
Economics	17	(3)	3	3	6
M.S. & P.E.	471, 500	(2)	4	2	6

SUMMER TERM: Work in Shipyard on Hull Construction, with report, 458, 8 weeks (3)

JUNIOR YEAR

FIRST TERM	N	C	R	P	T
Str. of Mat.	167	(4)	4	8	12
Str. Mat. Lab.	168	(1)	3	0	3
Naval Arch.	452	(3)	3	5	8
Astron. & Nav.	150	(4)	4	8	12
Heat Engr.	218	(3)	3	6	9
F. E. & Mar. Ins.	28	(2)	2	4	6
Physical Ed.	500	(1)	2	0	2

SECOND TERM	N	C	R	P	T
Hydraulics	170	(3)	3	6	9
Hyd. Lab.	171	(1)	3	0	3
Naval Arch.	453	(4)	4	10	14
Navigation	153	(2)	2	4	6
Marine Engr.	454	(4)	4	8	12
Finance	18	(2)	2	4	6
Physical Ed.	500	(1)	2	0	2

SUMMER TERM: At Sea, with report, 458, 8 weeks (3)

SENIOR YEAR

FIRST TERM	N	C	R	P	T
Ship Design	455	(3)	6	3	9
Marine Engs.	219	(3)	3	6	9
Str. Steel Des.	176	(4)	6	6	12
Engr. Lab.	220	(1)	3	0	3
Admiralty Law... or Spanish	32a / 110	(2)	2	4	6
Dyn. & Mot.	354	(2)	2	4	6
Dyn. Lab.	355	(1)	3	1	4
Physical Ed.	500	(1)	2	0	2

SECOND TERM	N	C	R	P	T
Ship Design	456	(3)	6	3	9
Ship Operation	459	(2)	2	4	6
Term. Facilities	457	(2)	2	4	6
Engr. Lab.	226	(1)	3	0	3
Foreign Trade	29	(3)	3	6	9
English / or Spanish	127 / 110	(3)	3	3	6
Alt. Cur.	375	(2)	2	4	6
Dyn. Lab.	356	(1)	3	1	4
Physical Ed.	500	(1)	2	0	2

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

LIST OF STUDIES

Following is a complete list of studies offered by the University in its various courses. The number of exercises a week in each subject is indicated by the figures in parentheses. Two hours of drawing, three of work in the laboratory or three of practice in the field are regarded as equivalent to a recitation or lecture of one hour's duration.

UNDERGRADUATE COURSES

PHILOSOPHY, PSYCHOLOGY AND EDUCATION

PROFESSOR HUGHES, ASSISTANT PROFESSOR DROWN

1. General Psychology. Hunter's *General Psychology*, first term; MacDougall's *Social Psychology*, second term. A course for B.A. students. First and second terms (3).

2. Principles of Psychology. Hunter's *General Psychology*, first term; readings in applied psychology, with special emphasis on MacDougall's *Social Psychology* and Link's *Employment Phychology*, second term. A course for Business Administration students. First and second terms (2).

3. Psychological Problems. Measurement of intelligence. Studies in genius and in mental deficiency and abnormality. First term (2).

4. Social Psychology. The group mind. The relation to essential human needs of the several forms of culture: sport, art, the moral and religious consciousness, the spirit of science; their origin and development. Second term (2).

5. Economic Psychology. An introduction to such works as Link's *Employment Psychology*, Tead's *Instincts in Industry*, and texts on advertising and salesmanship. A course especially intended for students in engineering. First or second term (1).

6. Experimental Psychology. A course for Seniors who wish to follow up some line of investigation touched on in the Junior year. First and second terms (1).

PHILOSOPHY

7. History of Philosophy. An introduction to the philosophical method of dealing with the essential problems of an epoch. Leighton's *Field of Philosophy*. First term (2).

8. History of Philosophy, continued. The philosophical enterprises of recent years. Perry's *The Present Conflict of Ideals.* Second term (2).

9. Scientific Method. Sellars' *Essentials of Logic;* Dewey's *How We Think.* Sophomores. Second term (3).

EDUCATION

10. History of Education. Special emphasis upon Greek education and upon the roots of our present educational systems and methods. Graves' *History of Education.* First term (3).

11. Introduction to High School Teaching. A preliminary discussion of teacher and adolescent as the personal factors of the problem. The conduct and routine of class room practice, methods, types of lesson, daily plans, questions, devices and illustrative material, economy in teaching, discipline, tests, reports, etc. Colvin's *Introduction to High School Teaching.* Collateral readings. First term (3).

12. Principles of Secondary Education. The fundamentals of method, including the philosophy of the project method. Dewey, Kilpatrick, Thorndike and Hosic. Problems of administration, including a study of the development of secondary school systems, junior high schools and junior colleges. Social factors. Problems of the curriculum. Inglis' *Principles of Secondary Education.* Second term (3).

13. Senior Education. Preparation for the type of teaching position the student expects to fill. Special Method: in Latin, course 54, Professor Wright; in German, course 83, Professor Palmer; in Romance Languages, course 96, Professor Fox; in Physics, course 336, Professor MacNutt. Specialization in certain other fields under the supervision of a competent teacher in nearby public or private schools, as stated on page 38. Observation with practice teaching required of all students taking this course. First and second terms (3).

14. Practice Teaching. Work in connection with other courses and extra work. The student who seeks the State Department's provisional college certificate to teach (see page 38) should take practice teaching yielding at least five term hours of college credit. Three of these hours may be supplied by work in courses 10 and 11 and two to four hours by work in

course 12; extra work along desired lines may be arranged, yielding credit of one term hour in any given term. (1)

15. Science and Scientists. Given as part of course 47. The intellectual development of man revealed as the underlying cause of social and political progress. Libby's *An Introduction to the History of Science.* First and second terms (1).

BUSINESS ADMINISTRATION

PROFESSORS STEWART AND FOX, ASSOCIATE PROFESSOR BICKLEY, ASSISTANT PROFESSORS CURTIS AND MAC GREGOR

ECONOMICS

16. Economics. A study of the elementary principles of political economy. Lectures and required reading in selected works. First term (3).

17. Economics. Practical economic problems; taxation, transportation, finance, labor, trusts, and monopolies. Second term (3).

18. Business Finance. A study of the financial needs of the different forms of industrial organization, including individual proprietorship, partnership, corporation, and holding company, together with various means of meeting these needs. Second term (2).

18a. Corporation Finance. A study of the means of financing a corporation, including the sale of commercial paper, common and preferred stock, debenture and mortgage bonds, promotion of new corporations, underwriting, re-organization and receivership. First and second terms (3).

19. Public Finance. Government expenditures and their relation to the functions of government and to social, political and industrial conditions; formulation of budgets; nature and employment of public credit; origin and growth of public debts; revenues from various sources, with reference both to the theory and to the practice of various nations. First and second terms (3).

20. Accounting Theory and Practice. A study of the fundamental principles of accounting with sufficient practice work to illustrate these principles. Theories of debit and credit; single and double entry; construction of accounts; special books; distinction between capital and revenue and the problem involved;

construction and analysis of financial statements; equity accounts; valuation of assets; methods and problems of depreciation. The economic aspects of accounting emphasized. First and second terms (3).

21. Corporation Accounting. (Elective, Junior year.) The application of accounting principles to corporations, corporation accounts and records. The voucher system; construction and analysis of corporate statements and reports; assets of corporations and their valuation; capital stock and the stock books; bonds and other forms of indebtedness; distribution of profits; handling surplus and reserves; sinking and other funds; liquidation of a corporation; combinations and consolidations; branch house accounting. Considerable practice work given during the second term. The problems are selected largely from examinations for Certified Public Accountancy. First and second terms (3).

21a. Auditing. (Elective, Senior year.) Procedure in conducting an audit; detection of errors and defalcations; financial conditions of a business as revealed by the accounts and other sources of information. The social responsibilities of auditing. First term (3).

21b. Cost Accounting. (Elective, Senior year.) The various systems of manufacturing accounts for different types of manufacturing enterprises; choice of methods to meet peculiar needs; installing cost systems; forms and records; manufacturing accounts as an aid to and as a check on production efficiency; preparation of reports for executives. Second term (3).

22. Transportation. Development of transportation facilities. Consideration, from the administrative viewpoint, of railways and waterways as factors in the social and industrial development of the United States. The organization of railways, considering charters and franchises, capital stock, directors and stockholders. The administration and operation of railways, considering the activities of the various departments,—transportation, traffic, executive, financial, and legal. Relations between railroads and their employees. Public regulation and control of transportation facilities. First and second terms (2).

23. Labor Legislation and Administration. Labor problems confronting the employer and the more successful methods

of meeting them and avoiding legal disputes. The legal status of unions and strikes. Protection of the employer's interests. Employer's Liability and Workmen's Compensation Acts. First and second terms (3).

24. Development of Economic Thought. The rise and development of economic systems and economic thought; the scope and method of political economy. Patten's *Development of English Thought* and the works on political economy of Keynes, Cohn and Ingram. First and second terms (3).

25. Investments. A comparative study of investment values (including bonds, stocks, notes, and mortgages) and the conditions affecting the investment market; with the emphasis on the securities of corporations as investments. First and second terms (3).

26. Statistics. Statistical method and applied statistics. Practice in the handling and especially in the interpretation of statistics. As much research as possible carried on. First and second terms (3).

27. Banking and Currency. A study of the banking system of the United States, comparing it with those of the important European states, together with a study of the currency and currency problems of this country. Special emphasis laid upon the Federal Reserve Act, foreign exchange, and factors affecting the money market. First and second terms (3).

28. Foreign Exchange and Marine Insurance. Foreign monies and exchange ratios, financing of exports and imports, factors determining exchange rates, statistical studies in the field of foreign exchange, instruments and forms used in foreign trade; principles of insurance and the peculiarities of marine risks and policies. First term (2).

29. Foreign Trade. An historical and statistical study of international trade; the organization of steamship lines; combines, export associations, and rate agreements; line and charter traffic and trade routes. A study of steamship ports and the influence of the hinter land with special attention to the relations of navigation or inland waterways and railway transportation to ocean commerce. Also a study of the special methods necessary for successful trading with certain undeveloped but progressing nations. Second term (3).

30. Summer Reading in Economics. Assignments for summer of 1922. Freshman: Resources. Van Hise's *The Con-*

servation of Natural Resources. Sophomore: INDUSTRIAL SOCIETY. Marshall's *Readings in Industrial Society.* Junior: INDUSTRIAL ADMINISTRATION. Webb's *The Works Manager Today;* Gantt's *Organizing for Work;* Tead's *Instincts in Industry.* (1)

LAW AND POLITICAL SCIENCE

30a. BUSINESS ENGINEERING. The organization and financing of business associations, economics, accounting, finance. For Senior students in Engineering. First and second terms (3).

31. ELEMENTS OF BUSINESS LAW. The principles of contract; formation of contracts; operation and discharge of contracts. First term (2).

32. ELEMENTS OF BUSINESS LAW. Principal and agent; master and servant; sales of goods; negotiable instruments; business associations; partnerships and corporations. Second term (2).

32a. ADMIRALTY AND MARITIME LAW. Study of the principles and rules which regulate the conduct, the business and the property in matters of admiralty and maritime character. First term (2).

33. CONSTITUTIONAL LAW. The constitutional framework and the practical operation of the Federal and State governments. The relation of government to the business and social interests of the people. Interpretation of the Constitution by the various departments of the government. Comparison of American and European practice. First and second terms (3).

34. INTERNATIONAL LAW. The development of international law; its origin and history; economic and political changes determining the development of international relations; the Jus Gentium of the Roman Law and the "Natural Law" jurists. Law of Peace and War: general principles governing the normal relations of states and their relations in time of war. The Law of Neutrality, with special reference to the contributions of the United States; problems associated with blockade, contraband of war, unneutral service. First and second terms (3).

ECONOMIC GEOGRAPHY

35. ECONOMIC GEOGRAPHY OF NORTH AND SOUTH AMERICA. Physical features, climate, and resources of the Western Hemisphere; their influence upon the economic, political, and

social institutions. The present and prospective commercial relations of the United States with Mexico, Central and South America. First and second terms (3).

36. Economic Geography of the Eastern Hemisphere. Physical features, climate, and resources of the Eastern Hemisphere; their influence upon the economic, political, and social institutions. Study of Great Britain, Germany, Russia, China, Japan, India and the Philippine Islands; the present and prospective commercial relations of these countries with the United States. First and second terms (3).

HISTORY

PROFESSOR STEWART,

ASSISTANT PROFESSORS CURTIS AND MAC GREGOR

38. Industrial History. The evolution of modern industrial conditions as found in the growth of the economic powers of Great Britain, Germany and the United States. First and second terms (4).

39. The Political and Constitutional History of the U. S. Prior to 1860. The era of constitution making, state and federal. Rise and growth of party government. The development of nationality and democracy. Political and constitutional questions arising in connection with internal improvements, the tariff, the bank and slavery. First term (3).

40. Political and Constitutional History of the U. S. Since 1860. Continuation of course 39. Second term (3).

41. European History. The formation of the modern European nationalities. The rise of the universities. The revival of learning. The Reformation. The relations of Europe and America. First term (3).

42. European History. The history of modern Europe. The development of Great Britain. The French Revolution and the history of the Nineteenth Century. Second term (3).

43. American Foreign Relations. Studies in the diplomatic relations of the United States with the main countries of Europe, with the Near East and the Far East. First term (3).

44. United States and Latin America. Problems arising out of the relations of South American states to one another and to the United States. Origin, development and application of the Monroe Doctrine. Second term (3).

LATIN

PROFESSOR WRIGHT

45. Ovid. Selections from the *Metamorphoses*. Vergil. *Bucolics*. Horace. Select *Odes*. Lectures on the history and development of pastoral and lyric poetry. The influence of Latin poetry upon English literature emphasized. Insistence upon tasteful translation. Freshman. First term (3).

46. Horace. *Odes* continued. Catullus. Selections. Constant practice in reading the more important lyric metres. Memorizing of stanzas and passages from Horace. Freshman. Second term (3).

47. Ancient and Mediaeval Civilization. A course aiming to impart a knowledge of ancient and mediaeval life and thought, with special emphasis on literature, art, science and philosophy. Required readings in the best English translations of ancient authors. Assigned topics for investigation and report. Lectures on the art, architecture and daily life of the ancients, illustrated by stereopticon. Freshman. First and second terms (3).

Courses 45 and 46 are required of Freshmen in the B.A. course who enter with four units of Latin; others in that course take 47, except that those who present three units in Latin for entrance may, upon the approval of the Professor of Latin, continue Latin instead.

48. Livy. Selections from the books covering the war with Hannibal. Latin prose composition; or: Cicero. *De Senectute. Letters.* Catullus. A study of the literature and social life of republican Rome. Sophomore. First term, elective (3).

49. Plautus and Terence. Careful study of a play of each with rapid reading of as much more as time permits. Private life of the Greeks and Romans. History of the drama at Rome. Sophomore. Second term, elective (3).

50. Satire. Selected satires of Horace and Juvenal. Martial. Selected epigrams. Lectures on the history of Roman Satire and its influence on modern literature. Study of social conditions under the Empire. Junior and Senior. First term, elective (3).

51. Petronius. *Cena Trimalchionis;* or an advanced course in Comedy. Study of the language, syntax, and vocabulary of the *Sermo Plebeius*. Junior and Senior. Second term, elective (3).

52. VERGIL. *Aeneid*, Books VII-XII. Lectures on the history of the Epic. Writing of brief dissertations on assigned topics. Juniors or Seniors. First term, elective (3).

53. LUCRETIUS. Careful study of one book entire of the *De Rerum Natura*, with reading of selections from the other books. Consideration of textual questions. Discussion of ancient materialistic theories. Some review of Roman philosophy and ethics. Junior or Senior, elective, second term (3).

54. Courses for prospective teachers of Latin in secondary schools. Largely a review of secondary school Latin, the members of the class conducting the class in turn under the oversight of the Professor of Latin to the end that they may enter upon the teaching of Latin in preparatory or high school with freshened knowledge of the subject, and not without some experience in presenting it. Junior year, first term (2), second term (2). This course ordinarily taken in connection with EDUCATION, which see.

GREEK

PROFESSOR GOODWIN

55. LYSIAS, Selected *Orations;* or XENOPHON, *Memorabilia.* Review of the Grammar. Composition and other exercises. Careful study of Attic prose syntax; special attention given to the formation of correct methods of study and translation, to grammatical analysis, and the reading aloud of Greek. Available time employed in sight-reading. HERODOTUS. One book begun. First term (3).

56. HERODOTUS (continued). Study of the forms and syntax of the Ionic dialect. PLATO. *Euthyphro, Apology*, or other shorter dialogues. Introduction to Greek Philosophy. Grammar and composition as in the first term. Second term (3).

57. THUCYDIDES. One or more books. Practical exercises, including composition. First term (3).

58. TRAGEDY. EURIPIDES. *Medea, Bacchae*, or another play. SOPHOCLES. *Oedipus Tyrannus, Antigone*, or another. Literary study of the drama. Poetical language, style, and conception. Metrical reading. Composition. Second term (3).

59. DRAMATIC POETRY (continued). AESCHYLUS. *Agamemnon*, or *Prometheus Bound.* ARISTOPHANES. *Clouds, Frogs*, or *Birds.* ARISTOTLE. Chapters from the *Poetics.* Aristophanes as humorist and as moralist, with consideration of the tend-

encies which he satirized. Metres. Elementary text-criticism. First term (3).

60. Greek Oratory. Jebb's *Selections from the Attic Orators.* Demosthenes. Selected orations. Rapid reading, the student being supposed to have reasonable facility in understanding the Greek directly without rendering into English. Attention directed largely to those points which illustrate the development of Greek prose style. Second term (3).

61. Homer. Rapid reading of considerable portions of the *Iliad* or *Odyssey.* Homeric language, syntax, and metre reviewed, with some reference to the needs of intending teachers, but chiefly as a foundation for the study outlined in course 62. First term (3).

62. Lyric Poetry. Fragments of the Elegiac, Iambic, and Melic Poets. Selections from Pindar or Theocritus. Study of the development of poetry in Greece. Second term (3).

63. Hellenistic Greek. *New Testament.* Selections from Lucian. To be substituted on occasion for 62. Second term (3).

Courses 59 and 61, 60 and 62 (or 63) are offered in alternate years, and are open to both Juniors and Seniors. Candidates for honors in Greek will be assigned special readings on request.

64. Elementary Greek. A course offered (ordinarily only in alternate years) to Freshmen and Sophomores who have entered without Greek, but who desire to take up the study in college. They perform in two years approximately the amount of work required for admission from those who present Greek, and are prepared to proceed in the third year with course 55. The introductory book and a small portion of the *Anabasis* studied in the first two terms. Given in 1921-1922; to be omitted in 1922-1923. First and second terms (3).

65. Elementary Greek, second year. *Anabasis* continued; *Iliad* (if time permits); Grammar and simple Composition. Omitted in the years in which the preceding course is given. First and second terms (3).

GERMAN

PROFESSOR PALMER, ASSISTANT PROFESSOR MORE, MESSRS. ROEST AND LUFT

70. Elementary German. German Grammar and Composition. Easy German texts. First term (3).

71. Elementary German, continued. Composition based on work in the Grammar. Dictation. Reading of short stories by various modern authors. Second term (3).

72. Elementary German. A condensed course for Chemists, Chemical Engineers and Metallurgists who have entered without German. Grammar. Readings in the German of Chemistry. First and second terms (3).

73. German. Rapid reading of selected texts on chemistry. For Sophomores who have passed course 72. First term (1) or (2).

74. Scientific German. Rapid reading of scientific texts. For Seniors in the Department of Chemical Engineering who offered French or Spanish for entrance. Preparation required: 72 or equivalent. Second term (3).

75. German. Thorough review of German Grammar. Prose composition. Modern German Prose; Scientific German. First and second terms (3).

76. German. The German of Chemistry. Review of German Grammar. Composition. First and second terms (3).

77. German. German Prose and Poetry. Heine, Keller, C. F. Meyer, Freytag, Storm, Heyse. Composition. First and second terms (3).

78. German. Modern German Prose. Rapid reading of representative texts. First term (3).

79. German. Goethe's *Faust*. Study of Part I. Lectures on the origin and development of the Faust story. Second term (3).

80. German. Nineteenth Century German Drama. Lectures, reading, reports on assigned work. First and second terms (3).

81. German. Goethe's Dramas: *Goetz*, *Egmont*, *Iphigenie*, *Tasso*, *Faust*, Part II. First and second terms (3).

82. German. The German Short Story, its origin and development. Rapid reading of illustrative stories, with particular attention to Gottfried Keller, Theodor Storm, C. F. Meyer, and Paul Heyse. Lectures and reports. First and second terms (3).

83. German. A course for prospective teachers in advanced German grammar, German composition, methods of teaching and discussion of text-books. First term (2).

ROMANCE LANGUAGES

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY,
MESSRS. EWING, FORTE, BARTHOLD

90. Elementary French. Elementary French Grammar. Easy readings in French prose. Practice in speaking and writing simple French, based upon the texts used. A course intended primarily for Junior students in the College of Arts and Science; introductory to course 97. First and second terms (3).

91. Elementary French. An intensive course in Elementary French for Senior Metallurgists. Emphasis upon the development of a reading knowledge of French. Grammatical drill limited to the essentials. First term (3).

92. Elementary French. A Sophomore elective for students in the College of Arts and Science who wish three years of French and can therefore give time to a more detailed drill in grammar and composition as well as practice in writing and science; introductory to course 97. First and second terms (3).

93. French. A course for students who wish a greater opportunity to practice in the oral and written use of modern French prose. Especially recommended for those who expect to teach French. First and second terms (2).

94. French. A course for Freshmen who enter on French. Thorough review of the grammar with composition work, both oral and written, based upon the grammar and upon the texts read. Texts selected from writers of modern French prose. First and second terms (3).

95. French. Primarily for students in Ship Construction and Marine Transportation who elect to continue the French of their Freshman year. Rapid reading of modern French authors, introducing certain of the social and political problems of France and her people today. Reading of texts by such authors as Thiers, Lamartine and Michelet, to furnish the necessary background. First and second terms (3).

96. French. Text and methods. First or second term, or both (1) or (2).

97. French. Rapid reading. Sight translation. Dictation. Oral drill in the use of a practical vocabulary. First and second terms (3).

98. French Prose and Poetry. Balzac, Flaubert, Maupassant, Daudet, Zola. First term (3).

99. French Prose and Poetry. Continuation of course 98. Molière, Corneille, Racine. Society in the seventeenth century. Second term (3).

100. French. French literature in the seventeenth century. First term (3).

101. French. French literature in the eighteenth century. Second term (3).

102. French. French literature in the sixteenth century and earlier. First and second terms (3).

103. French. General review of French Literature. Reading, lectures and explanation of texts. First and second terms (3).

104. French. French literature in the nineteenth century. First and second terms (3).

SPANISH

110. Spanish. Grammar, reading and composition. A course open to all students of the University. First and second terms (3).

111. Spanish. Preparation required: 110 or equivalent. Reading and discussion in Spanish of texts dealing with the history of Latin American countries. Prose Composition. First and second terms (3).

112. A continuation of course 110. First and second terms (3).

113. Spanish. Reading and discussion in Spanish of texts dealing with the commercial and industrial relations of Latin America. Spanish commercial correspondence. First and second terms (3).

114. (Alternate.) Spanish novels and plays. Short outline of Spanish literature. A second year course, intended more especially for students in the B.A. course; may be substituted by them for course 112. First and second terms (3).

PORTUGUESE

115. Portuguese. Grammar and composition. Rapid reading of modern literature, with particular reference to the history, social and economic conditions of Brazil and Portugal. First and second terms (3).

116. PORTUGUESE. A continuation of course 115. First and second terms (3).

ITALIAN

117. ITALIAN. Grammar and composition. Rapid reading of easy modern prose. First and second terms (3).

118. ITALIAN. Masterpieces of the classic periods; outside reading. First and second terms (3).

ENGLISH

PROFESSORS THAYER AND LUCH,
ASSISTANT PROFESSOR MESCHTER, MR. LAMBERT

120. RHETORIC. A composition course based on Genung's *Working Principles of Rhetoric* and other books, involving recitations and weekly themes on assigned subjects. First term (2).

121. AMERICAN LITERATURE. Lectures on the basis of Cairns' *History of American Literature* and other text-books, as assigned. Examination based upon the text-book and the student's notes. First term (1).

122. HISTORY OF THE ENGLISH LANGUAGE. Lectures and classroom work, with the use of Emerson's *Brief History of the English Language* as a text-book, supplemented by Lounsbury's and Champneys'. Second term (2).

123. ENGLISH LITERATURE. An outline course developed by lectures and recitations, with parallel readings assigned annually. Text-book: Pancoast's *English Literature* with a standard book of selections from English Literature. First term (2) or (3).

124. LITERARY CRITICISM. Subject varying annually between topics taken from Elizabethan Literature, lyric or dramatic, and from Nineteenth Century Literature, earlier or later period. In 1922, Scott, Byron, Shelley, Keats and Landor. Second term (2) or (3).

125. ORATORY. A formal course based upon Foster's *Argumentation*, with recitations and writings of briefs, the composition and delivery of orations, and speeches on topics of current interest. First and second terms (1).

126. ANGLO-SAXON. Sweet's *Anglo-Saxon Primer and Reader*, with lectures on early English Literature, and readings from Brooke and Earle. First term (3).

127. Technical Writing. A course of practical exercises in writing on scientific subjects. Text-book: Earle's *Technical Writing*. Second term (2), (3) or (4).

128. English Philology. The principles of the Philology of the English language as developed in the works of Earle, Trench, Morris and Skeat. By a process of elimination the elements derived from Romance and other sources are excluded, and the residuum examined, in vocabulary and grammar, as a Teutonic language; with special reference to the intensive development of the tongue before the Age of Chaucer. Preparation required: 126. Second term (3).

129. Nineteenth Century Literature; later period 1830-1892. A special study of Tennyson, Arnold and Browning and some of the minor poets. Junior elective. First term (3).

130. Middle English. A critical study of the English of Chaucer, Langland, Wiclif and Gower; followed by the literary study of selected specimens of their works. Text-books, *The Student's Chaucer*, Skeat's edition of *The Vision of Piers the Plowman*, Wiclif's translation of the *New Testament*, revised by Purvey, and Gower's *Confessio Amantis* assigned. First term (3).

131. Poetics. A course based on Gummere's *Handbook of Poetics*, Alden's *English Verse*, Saintsbury's *Loci Critici*, and the use of Palgrave's *Golden Treasury*, and *The Oxford Book of English Verse*, with practical exercises in verse-composition. Senior elective. Second term (3).

132. Drama of the Past. Based on Brander Matthew's *Chief European Dramatists;* with lectures, interpretations and a close study of plots and sources. First term (3).

133. Contemporary Drama. Lectures, criticisms and reading of typical plays. In 1922, American Drama down to date. Second term (3).

134. Twentieth Century Literature. The drama, novel, and lyric poetry since 1895. Junior elective. Second term (3).

135. The Danish Element in English. A philological study based on Sweet's *Icelandic Primer*, Groth's *Danish Grammar* (pp. 1-29, 67-143) and the works of Jespersen and other philologists. Alternative with 130. Preparation required: 126, 128. Second term (3).

136. Optional courses on the Rise and Development of the English Novel and on the Arthurian Cycle offered in alternate years. Lecture courses, with private reading assigned; if supplemented by a rigid examination, taken as equivalent to one term's work in any class above the grade of Freshman.

137. ENGLISH CONFERENCES. First or second term (1), (2) or (3).

MATHEMATICS AND ASTRONOMY

PROFESSORS THORNBURG, LAMBERT AND OGBURN

ASSOCIATE PROFESSORS STOCKER AND REYNOLDS,

ASSISTANT PROFESSOR KNEBELMAN, MESSRS. LEYZERAH, SOLT, BUNN

140. SOLID GEOMETRY, beginning with Book VI and completing the subject. Second term (3).

141. TRIGONOMETRY. Plane Trigonometry, including the theory and use of logarithms. First term (3).

142. TRIGONOMETRY. Spherical Trigonometry, including the use of logarithmic tables. Second term (1).

143. ADVANCED ALGEBRA, beginning with the Theory of Quadratic Equations. Review of Plane Trigonometry and Elementary Algebra. First term (4).

144. HIGHER ALGEBRA. Theory of Equations and other topics. First term (1).

145. PLANE ANALYTIC GEOMETRY. Graphic representation of loci on cross-section paper, plane analytic geometry. Second term (3).

146. DIFFERENTIAL CALCULUS AND SOLID ANALYTIC GEOMETRY. Embracing applications to analytic geometry and practical problems. Preparation required: 145. First term (4).

147. INTEGRAL CALCULUS. General integration methods with applications to theory of center of gravity, moment of inertia, together with a short chapter on elementary ordinary differential equations. Preparation required: 146. Second term (4).

148. DIFFERENTIAL EQUATIONS. Preparation required: 147. First term (1).

149. ANALYTIC MECHANICS. Differential equations of motion, treatment of forces in space, free and constrained motion of a particle and of masses, with applications to practical problems. Preparation required: 147. First term (2).

150. Descriptive Astronomy. A study of the fundamental facts and principles of the subject with solution of problems; observatory visits. First and second term (4) or (3).

151. Practical Astronomy. Study of instruments used, methods of taking and reducing observations to determine time, latitude, longitude and azimuth; observatory work in which each student makes his own observations and computations in illustration of the problems studied. As this study is primarily for civil engineers, the sextant and engineer's transit are the chief instruments employed in the observational work. Preparation required: 141, 147, 150. First term (3).

152. Analytic Mechanics. Preparation required: 147, 148, 149. Second term (3).

153. Navigation. Study of principles and instruments used in navigation, with practical navigation problems by modern methods. Second term (2).

CIVIL ENGINEERING

PROFESSORS FOGG, WILSON AND CHAPMAN,
ASSISTANT PROFESSORS BECKER, FULLER, PAYROW, LEWIS, AND UHLER, MR. CLARK

160. Engineering Drawing. The use of drawing instruments. Lettering and tracing. Mechanical drawing of objects. Simple projections. Isometric Drawing. First term (3).

161. Engineering Drawing. The descriptive geometry of projections, intersections, and developments. Plans, elevations and sections of simple structural details. Preparation required: 160. Second term (2).

162. Engineering Drawing. The use of drawing instruments, lettering and simple projections. Second term (1).

163. Engineering Drawing. The descriptive geometry of projections, intersections and developments. Isometric drawings, plans, elevations and sections of simple structural details. Preparation required: 163. Second term (2).

164. Engineering and Topographic Drawing. Problems in stone cutting, including plans for pipes, culverts and arches. Isometric drawings and linear perspective. Topographic maps. Preparation required: 163. Second term (2).

165. Land and Topographic Surveying. The theory and practice of land surveying, including computation of areas, dividing

land, determining heights and distances. Map drawing and topographic signs. Field work with level and transit. Map drawing from students' field notes. Theory and use of stadia. Detailed field work in rough country; pen topography and contour maps. Preparation required: plane trigonometry and engineering drawing. Summer term: a recitation and seven hours of field work each week-day for three weeks, beginning June 14, 1922.

166. Railroad Surveying. Reconnaissance, preliminary and location methods, with the theory of curves. Preparation required: 165. Summer term: a recitation and seven hours of field work each week-day for two weeks, immediately following course 165.

167. Strength of Materials. The elasticity and strength of timber, brick, stone, and metals. Theory of beams, columns, and shafts, with the solution of many practical problems. Preparation required: 320, 321, 323, 147. First term (4).

167a. Strength of Materials. An abridgment of course 167. Preparation required: 320, 321, 323, 147. First term (3).

168. Strength of Materials Laboratory. Fourteen experiments made by each student on wood, iron and steel to determine the action of materials under stress and to study the physical properties of materials of construction. The Fritz Engineering Laboratory, where this work is done, is equipped with 20,000, 50,000, 100,000, 300,000 and 800,000-pound machines for tension, compression, and flexure, a 50,000-inch-pound machine for torsion and other apparatus for special work. In conjunction with 167 or 167a. Fee, $5. First term (1).

169. Railroads. Theory of curves and turnouts. Preparation of profiles and maps. The computation of earth work and estimates of cost. The construction of road-bed, including ballast, cross ties, rails, switches, culverts and other details. Preparation required: 166. First term (4).

170. Hydraulics. Hydrostatics and theoretical hydraulics. The flow of water through orifices, weirs, tubes, pipes, and channels. Naval hydromechanics. Hydraulic motors. The solution of many practical problems. Preparation required: 320, 321, 323, 147. Second term (3).

170a. Hydraulics. An abridgment of course 170. Preparation required: 320, 321, 323, 147. Second term (2).

171. Hydraulic Laboratory. Fourteen experiments made by each student in the hydraulic section of the Fritz Engineering Laboratory, which is equipped with pumps, weirs, turbines, water-wheels, meters and other apparatus for special work. In conjunction with 170 or 170a. Fee, $5. Second term (1).

172. Roofs and Bridges. Analytical and graphical determination of stresses in roof and bridge trusses under dead, live and wind loads. Locomotive wheel loads on plate girders and bridge trusses. Preparation required: 167. Second term (4).

173. Highway Engineering. The location, construction and maintenance of roads and pavements. Highway design. Preparation required: 165, 166. Second term (3).

174. Graphic Statics and Surveying. A special course given to Junior Mechanical Engineering students. The first part of the term devoted to the graphical determination of stresses in roof trusses by the force polygon. The last part of the term devoted to elements of plane surveying, including field work. Second term (3).

175. Structural Steel Design. Lectures and recitations. Theory of structural steel design and complete calculations for a through plate girder railroad bridge and for a highway truss bridge. Design of mill buildings and miscellaneous structures. Preparation required: 172. First term (3).

176. Structural Steel Design. A special course arranged for Seniors in Ship Construction and Marine Transportation. A study of the stresses acting on steel structures, with special attention to the local stresses in a ship's structure; the design of cranes, warehouses and other steel structures; solution of problems by graphical methods. Preparation required: 167. First term (4).

177. Bridge Design Drawing. Complete shop drawing for a single track through railroad bridge and a design drawing of a highway truss bridge for which calculations are made in course 175. Preparation required: 172. First term (3).

178. Graphic Statics. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to the discussion of beams and girders. First term (2).

179. Hydraulic and Water Power Engineering. Three recitations and one drawing-room exercise a week devoted to

systems of water supply, including purification systems, reservoirs, pipe lines, pumping plants. The design of a water supply distribution system. The measurement of flow in open channels by means of tubes and meters. Water power. Irrigation. Preparation required: 170. First term (4).

180. Geodesy. Recitations, calculations, field work. Precise leveling. Adjustment of instruments with investigation of their systematic errors. Elements of least squares and their application to the adjustment of triangulations. Field work in triangulation, in determination of azimuth, and with the plane table. Preparation required: 165, 166. First term (3).

181. Railroads and Terminals. Maintenance of way, and the elements of railroad operation. Lectures on the economics of railroad location; the arrangement of yards, stations and terminals, train resistance, the application of electricity to the operation of railroads. Preparation required: 169. First term (3).

182. Higher Structures. Theory of continuous, draw, cantilever and suspension bridges, also metallic arches. The theory and design of masonry walls, dams, and arches. Theory of deflections and applications to statically indeterminate structures. Preparation required: 175. Second term (3).

183. Reinforced Concrete Design and Foundation. Theory of reinforced concrete; design of reinforced concrete buildings, arches and miscellaneous structures. Foundations. Preparation required: 175. Second term (3).

184. Cement and Concrete Laboratory. The manufacture, properties and testing of cement, mortar and concrete. All the standard tests made by each student on cement and on reinforced concrete beams and columns in the Fritz Engineering Laboratory. Preparation required: 183. Fee, $3. Second term (1).

185. Contracts and Specifications. Lectures on the essentials of contracts and specifications for engineering structures. Second term (2).

186. Sanitary Engineering. Systems of sewerage and methods of sewage treatment and disposal. The design of a sewerage system. House drainage. Preparation required: 179. Second term (3).

SUMMER SCHOOL IN CIVIL ENGINEERING

165. Land and Topographic Surveying. Exercises in Land and Topographic Surveying, designed primarily for students of the University, but open to all persons prepared to take them, are given in the summer vacation. In 1922, this work begins at 8 a.m., on June 14, and runs for three full weeks. Students in Civil Engineering, in Mining Engineering and in Ship Construction and Marine Transportation are required to take this work. The fee for other persons is $30.

166. Railroad Surveying. Exercises in railroad surveying, beginning immediately after the close of course 165 and running for two full weeks.

187. Summer Work in Civil Engineering. During the summer following the Junior year, students are required to spend at least eight weeks on shop work or on engineering construction.

MECHANICAL ENGINEERING

PROFESSORS LARKIN, DE SCHWEINITZ AND KLEIN,
ASSOCIATE PROFESSOR BUTTERFIELD,
ASSISTANT PROFESSORS BEAMENSDERFER, QUAST AND MEASE,
MR. NORDENHOLT

200. Drawing and Elements of Machine Design. Orthographic, isometric and oblique projections, intersections and developments. Sketches and working drawings of machine pieces, tracings, details of screw-fastenings, keys and other fastenings. French's *Engineering Drawing.* Fee, $1.50. First term (3).

201. Heat Engines. Classification and types of engines, governors, valve gears, valve diagrams, indicator diagrams, efficiency. Fuels, combustion, boilers, superheaters, feed water heaters, condensers. Hirshfeld and Barnard's *Elements of Heat Power Engineering.* First term (3).

202. Mechanism. A study of the mechanics of machine parts. Development of links, cams, gears, transmission machinery and the determination of dimensions from a standpoint of strength and durability taken up in detail in the class room. Practical problems developed in the drawing room. Schwamb, Merrill, and James' *Elements of Mechanism.* First term (3).

203. Elements of Machine Design. Calculation of the dimensions of elementary machine parts such as spur-, bevel- and worm-gears, pulleys, shafting, couplings, bearings, connecting rods, etc., from the forces acting upon or transmitted by such machine parts. Working drawings of these pieces. Leutwiler's *Elements of Machine Design.* Preparation required: 200. Fee, $2.50. Second term (3).

204. Heat Engines. Continuation of 201. Hirshfeld and Barnard's *Elements of Heat Power Engineering.* Second term (3).

205. Mechanism. Continuation of 202. Schwamb, Merrill, and James' *Elements of Mechanism.* Second term (3).

206. Graphic Statics of Mechanisms. Graphical determination of the forces acting on all the various pieces constituting a machine, covering a great variety of machines; drawings of these machines given to the students. Consideration of frictional and inertia resistances and determination of the efficiencies of mechanisms. Text: Department Notes and Plates. Preparation: 203, 205. Fee, $2.50. First and second terms (2).

207. Heat Engines. Theory of Steam Turbines, Internal Combustion Engines, Gas Producers and Refrigeration. Class and drawing room work. Preparation required: 204. Hirshfeld and Barnard's *Elements of Heat Power Engineering.* First term (4).

208. Engineering Laboratory. Use and calibration of apparatus for measuring weight, volume, pressure, temperature, speed, etc., for engineering purposes. Carpenter & Diederich's *Experimental Engineering.* Fee, $3.50. First term (1).

209. Heat Engines. Theory of Steam Turbines, Internal Combustion Engines, Gas Producers and Refrigeration. Continuation of 207. Hirshfeld and Barnard's *Elements of Heat Power Engineering.* Second term (4).

210. Engineering Laboratory. Work of 208 continued. Indicator practice on engines in the laboratory and in factories and power plants in the neighborhood; complete working up of indicator diagrams from simple and compound engines, air compressors, etc. Carpenter & Diederich's *Experimental Engineering.* Fee, $3.50. Second term (1).

211. Advanced Machine Design. The design of machines in general, with special attention to the calculation and designing of the various parts for strength, stiffness and other requirements. Problems covering such machinery as cranes, hoists, pumps, machine tools, hydraulic machinery, etc. Kimball and Barr's *Machine Design.* First term (4).

212. Mechanical Engineering. Advanced work in Thermodynamics, Internal Combustion Engines and Steam Turbines with typical problems. Emsweiler's *Thermodynamics*, Streeter's *Gas Engines*, and Moyer's *Steam Turbines.* First term (4).

213. Engineering Laboratory. Work of 208 and 210 continued. Test of boilers, of power plants and pumping stations in the neighborhood. Carpenter and Diederich's *Experimental Engineering.* Fee, $3.50. First term (1).

214. Thesis. Each candidate for the degree of Mechanical Engineer is required to present a satisfactory thesis on some topic, showing a grasp of the underlying principles of the subject investigated. Second term (3).

215. Advanced Machine Design. Continuation of 211, being more specialized. Kimball and Barr's *Elements of Machine Design.* Second term (4).

216. Mechanical Engineering. Continuation of 212. Advanced work in Pumping Machinery, Air Machinery, and Refrigeration, with typical problems. Greene's *Pumping Machinery*, Peele's *Compressed Air*, Goldman's *Financial Engineering*, and Greene's *Elements of Refrigeration.* Second term (4).

217. Engineering Laboratory. Work of 213 carried forward, along same lines. Analysis of flue gases; complete tests of power plants of the vicinity. Carpenter and Diederich's *Experimental Engineering.* Fee, $3.50. Second term (1).

218. Heat Engineering. The laws of gases and the gas cycles; the properties of steam and other vapors, the vapor cycles, entropy and the temperature-entropy diagram; a study of the theory of prime movers and the action of steam in engines and turbines; the use of the steam tables, the Mollier and temperature entropy diagrams. For students in the Course of Ship Construction and Marine Transportation. Hirshfeld and Barnard's *Elements of Heat Power Engineering.* First term (3).

219. Marine Engines and Turbines. A detailed study of the multiple expansion reciprocating engine, the steam turbine and the Diesel engine. A study of the theory, economy and design of these three prime movers in the class room, supplemented by work in the drawing-room and laboratory. For students in the Course in Ship Construction and Marine Transportation. Hirshfeld and Barnard's *Elements of Heat Power Engineering*, Moyer's *Steam Turbines*, and Morrison's *Oil Engine*. First term (3).

220. Engineering Laboratory. A shorter course, selected and condensed from 208, 210, 213 and 217, especially in steam engineering, for students in courses other than Mechanical Engineering. Carpenter and Diederich's *Experimental Engineering*. Fee, $3.50. First term (1).

221. Heat Engines. Short course for students in courses other than Mechanical Engineering, covering Steam Engines, Steam Turbines, Internal Combustion Engines and Boiler Plants. Hirshfeld and Barnard's *Elements of Heat Power Engineering*. First term (3).

222. Heat Engines. Work of 221 completed. Hirshfeld and Barnard's *Elements of Heat Power Engineering*. Second term (3).

223. Heat Engines. Classification and types of engines and power plant auxiliaries and apparatus, fuels, combustion, steam turbines, internal combustion engines; a composite course for students in the course in Chemical Engineering. Hirshfeld and Barnard's *Elements of Heat Power Engineering*. First term (3).

224. Heat Engines. Continuation of 223. Hirshfeld and Barnard's *Elements of Heat Power Engineering*. Second term (3).

225. Engineering Laboratory. A summer course of four weeks for students in Chemical Engineering, comprising a series of experiments and tests of heat transfer, apparatus, calorimetry, heat engines and auxiliaries. Preparation required: 223, 224. Carpenter and Diederich's *Experimental Engineering*. Fee, $3.50. Summer term (3).

226. Engineering Laboratory. Work of 220 completed, along same lines. Carpenter and Diederich's *Experimental Engineering*. Fee, $3.50. Second term (1).

METALLURGY

ASSOCIATE PROFESSOR ROUSH,
ASSISTANT PROFESSORS BUTTS AND PULSIFER

241. History of the Metals. A course of lectures designed to familiarize the beginning student with the historical phases of metallurgy and the importance of metals in the development of civilization. Preparation required: 390. Second term (1).

242. Introductory Metallurgy. A course of lectures on the distribution of the ores, of the various metals, their geographical distribution and conditions of their production; their present economic and mechanical importance. When possible to arrange, visits are made to metallurgical plants, to acquaint the student with the general features of metallurgical apparatus, their appearances and their working. Preparation required: 241. First and second terms (1).

243. General Metallurgy. Metallurgical processes. Principles of combustion. Application of thermo-chemistry. Measurements of high temperatures. Fuels, natural and artificial, solid, liquid and gaseous. Fluxing. Refractory materials. Classification of furnaces. Artificial draft and blast. Electric furnaces. Reference books: Hofman's *General Metallurgy;* Fulton's *Principles of Metallurgy.* Preparation required: 242, 398, 399. First term (2).

244. Metallurgical Problems. A course of problems embodying the use of the physical, chemical and mechanical principles as the basis of practical metallurgy. Data taken from actual practice, so that the results have an important bearing in the understanding of metallurgical processes. Reference: Richards' *Metallurgical Calculations, Part II.* Preparation required: 242, 397. Must accompany course 243. First term (1).

245. Metallurgy of Iron and Steel. Chemical and physical properties of iron. Iron ores. Preparation of ores. The blast furnace. The mixer. Remelting. Refining. Puddling. The Bessemer process. The open-hearth process. Duplex process. Cementation. Manufacture of crucible steel. Electric Steel. Alloy steels. Direct processes. Casting, forging and heat treatment. Reference books: Ledebur's *Eisenhüttenkunde;* Stoughton's *Metallurgy of Iron and Steel;* Austin's *Metallurgy of the Common Metals.* Preparation required: 243. Second term (2).

246. METALLURGICAL PROBLEMS. A course of problems involving the fundamental principles of the various processes in the metallurgy of iron and steel, to give the student an understanding of the quantitative relationships in the processes. Richards' *Metallurgical Calculations, Part II.* Preparation required: 243, 244, must accompany course 245. Second term (1).

247. METALLURGY. Short course. An abridgment of courses 243, 244, 245, and 246 for students in Civil, Mechanical, Electrical and Mining Engineering, Ship Construction and Marine Transportation. Reference books: Hofman's *General Metallurgy*, Stoughton's *Metallurgy of Iron and Steel*, Austin's *Metallurgy of the Common Metals*, Richards' *Metallurgical Calculations, Parts I and II.* Preparation required: 390, 397, 321, 324. First or second term (3).

248. METALLURGY OF COPPER, LEAD, SILVER, GOLD. COPPER: Chemical and physical properties. Ores. Smelting sulphide ores. The Bessemer process. Treatment of oxide ores. Wet process. Electrolytic processes. LEAD: Chemical and physical properties. Ores. Smelting processes. Condensation of lead fume. Refining and desilverization of base bullion. SILVER: Chemical and physical properties. Ores. Smelting with lead. Amalgamation. Leaching processes. GOLD: Chemical and physical properties. Ores. Gold washing. Gold milling. Chlorination. The cyanide process. Parting gold and silver. Reference books: Schnabel's *Handbook of Metallurgy*, Gowland's *Metallurgy of the Non-Ferrous Metals*, Austin's *Metallurgy of the Common Metals*, Hofman's *Metallurgy of Copper*, Hofman's *Lead*, Collins' *Silver*, Rose's *Gold.* Preparation required: 243; for Mining Engineers, course 247. First term (2).

249. METALLURGICAL PROBLEMS. A course of problems concerned with the principles utilized in the metallurgy of copper, lead, silver and gold. Reference: Richards' *Metallurgical Calculations, Part III.* Preparation required: 244. Must accompany course 248. First term (1).

250. METALLURGY OF ZINC, MERCURY, TIN, ALUMINIUM, NICKEL, ETC. ZINC: Chemical and physical properties. Ores. Belgian and Silesian processes for the manufacture of spelter. Manufacture of zinc oxide. Electrolytic processes. MERCURY: Chemical and physical properties. Ores. Processes of extraction. ALUMINIUM: Chemical and physical properties. Ores. Extraction by electrolysis. TIN, NICKEL, PLATINUM, ANTIMONY,

etc.: Chemical and physical properties. Ores. Processes of extraction. Reference books: Schnabel's *Handbook of Metallurgy*, Gowland's *Metallurgy of Non-Ferrous Metals*, Austin's *Metallurgy of the Common Metals*, Ingall's *Zinc*, Richards' *Aluminium*, Louis' *Metallurgy of Tin*, Wang's *Antimony*. Preparation required: 243. Second term (2).

251. Metallurgical Problems. A course of problems concerned with the principles utilized in the metallurgy of zinc, mercury, aluminium, etc. Reference: Richards' *Metallurgical Calculations, Part III*. Preparation required: 244. Must accompany course 350. Second term (1).

252. Electrochemistry. Lectures discussing the phenomena of electrolysis and the various theories proposed to account for them. Special consideration of secondary reactions, and also of the quantitative relations between electrical and chemical energy, and their mutual convertibility. Reference books: Le Blanc's *Text-book of Electrochemistry*. Allmand's *Applied Electrochemistry*. Preparation required: 398, 399, 419, 421. First term (1).

253. Electrometallurgy. Lectures discussing the practical application of electricity to metallurgical processes. Electrolytic and electric furnace plants and practice. Reference books: Borcher's *Electric Smelting and Refining*. Neuberger's *Handbuch der Praktischen Elektrometallurgie*. Preparation required: 243, 252. Second term (1).

254. Electrochemistry and Electrometallurgy. A combination of courses 252 and 253, for students in Electrical and Mining Engineering. Preparation required: 247. First term (2).

255. Electrochemical Laboratory. Quantitative relations in the deposition of metals by electrolysis. Experimental study of the conditions controlling the nature of electrolytic deposits. Electrolysis of fused salts. Cathodic and anodic reactions. Fee, $5. Must accompany course 252. First term (1).

256. Metallurgical Laboratory. Calibration and use of instruments employed in metallurgical investigations, pyrometers, calorimeters, etc. Determination of specific heats, latent heats of fusion and vaporization, vapor tensions, heats of combustion, heats of chemical combination and reaction. Heat conduction and radiation. Determination of efficiencies of furnaces. Experiments with electrochemical processes,

electric furnaces, etc. Preparation required: 243, 245. Fee, $10. Second term (2).

257. METALLOGRAPHY. The study of metals and alloys: their physical, chemical and microscopic properties together with deductions drawn therefrom. The influence of thermal and mechanical treatment on physical properties and structure. Lectures and laboratory work. Reference books: Gulliver's *Metallic Alloys*, Sauveur's *Metallography and Heat Treatment of Iron and Steel.* Preparation required: 243, 245, 167, 168. Fee. $10. First term (3).

258. SEMINARY. A conference hour of the staff of the Department with students, to discuss current metallurgical processes and problems, and thesis work, involving some reading of current literature and other preparation on the part of the students. First term (3). Second term (2).

259. THESIS FOR DEGREE. Presentation by every student in Metallurgy of a thesis on some topic which requires original literary and other work, such as observations, calculations, or experimental tests when practicable. Second term (3).

GEOLOGY

PROFESSOR MILLER, ASSISTANT PROFESSORS TURNER AND FRETZ, MR. STAAB

266. MINERALOGY. The principles of crystallography with practice in the determination of forms of models and crystals. The physical properties, origin, occurrence, association and alteration of minerals. A study of about two hundred of the common mineral species and varieties, particularly the rock-forming minerals, with practice in identification based on association and physical properties. Deposit, $5. First term (4).

267. BLOWPIPE ANALYSIS. A course in qualitative blowpipe analysis and special chemical tests in which the chemical and physical behavior of all the common chemical elements and their compounds under various conditions is noted. Methods of rapid qualitative tests as a means of identifying minerals and chemical compounds with the aid of the blowpipe. Fee, $4. First and second terms (1).

268. GENERAL GEOLOGY, A course in dynamic, structural, and historical geology. Text-book, supplemented by illustrated lectures in which the relation of geology to engineering problems is discussed. The different geologic periods and their

characteristic types of life. The principles of organic evolution as shown in the development of new forms in the successive periods are treated; also a brief review of the geology of the North American continent and the physical changes which it has undergone during its development. Second term (2).

269. Geological Laboratory and Field Trips. A study, during the winter months, of the various types of rocks, to enable students to determine and classify them without a microscope. Principles of rock classification presented in a series of lectures, supplemented by laboratory practice with a petrologic collection comprising rocks gathered from all parts of the country. Attention given to the examination of the varieties of rocks used for constructional purposes with discussions of the factors which render them desirable. A series of lectures on primary and secondary rock structures, supplemented by laboratory work on the interpretation and construction of topographic and geologic maps and sections. Field trips weekly, during the spring months, to nearby localities to study rock structures and deposits of economic importance.

The region furnishes excellent examples of varied structures and contains numerous quarries where slate, cement rock, limestone, sandstone, gneiss and serpentine are obtained, all of which are visited by the classes. On such field trips, special attention is given to the methods of geologic mapping. Fee, $1. Second term (2) or (1).

270. Economic Geology. A study of the origin, modes of occurrence, properties, sources, production, and uses of the nonmetallic mineral products. Comprehensive reports on various products. Preparation required: 266, 268, 269. First term (2).

271. Economic Geology. A study of the metallic mineral products. Causes of the formation of cavities in rocks, their relation to metalliferous deposits; discussion of the theories of ore-deposition; the structure, geologic horizon, and geographic distribution of the principal metallic economic deposits of the United States. Recitations, illustrated lectures, field trips, and laboratory work. Visits, for the purpose of studying ore occurrence, to the zinc mines of Franklin Furnace, N. J., and Friedensville, Pa., the magnetite mines if Dover, N. J., and Cornwall, Pa., and the anthracite coal regions. Preparation by each student of a series of maps illustrating the location, pro-

duction, and geology of the economic products of the United States. Preparation required: 266, 268, 269. Second term (4).

272. Paleontology. An elementary course in paleontology in which the animal life of the past is considered from both the biological and geological viewpoints. Theories of origin and evolution of life; principles of stratigraphy and paleontology. Study in the laboratory of index fossils of the successive geologic periods. Preparation required: 268, 269. Second term (3).

273. Geology of North America. The geological age and geographical distribution of the rocks of which North America is composed; the structure and history of its mountain ranges; the history of its geological development and origin; reviews of the great surveys that have been made. Lectures and laboratory work. Preparation required: 268, 269. Second term (3).

274. Physiography. The cosmic relations of the earth; the classification of land forms; the study of their origin, growth, and decay and the factors governing their development. Study of topographic and geologic maps. The relation of topography to geologic structure. The response of man and other organic life to an inorganic environment with special reference to the influence of physiography upon the economic development of countries. Brief study of weather and climate. Second term (2).

275. Field Geology. Geological maps—their use and the methods by which they are constructed. Practice in the actual working out of surface geology. Problems in plotting geology on topographic maps, each student being assigned a definite area and required to make a geological map of it with structure sections. Collection by each student of a full set of specimens to illustrate the geology. The first part of the course is devoted exclusively to field work and the notes and specimens are studied in the laboratory when the weather prevents further out-door work. Preparation required: 268, 269. Fee, $1. First term (3).

276. Petrography. The optical properties of minerals and their study with the petrographic microscope. Petrography of the more important igneous rocks. Lectures, recitations and laboratory work. Preparation required: 266, 325. Fee, $3. First term (2).

277. Physiography. A study of topographic forms and the processes that have produced them; the weather and climate; and the influence of physical conditions upon the development of countries. First term (2).

278. Physiography. A continuation of course 277. Recitations, lectures, laboratory work, and field trips. Physiographic regions of North America and Europe. Topographic maps and the preparation of weather and climate charts. Emphasis on the effect that physiographic conditions have in determining the commercial and industrial importance of nations. Second term (2).

279. Mining and Geologic Law. A study of the legal matters that confront a mining geologist. The law in regard to underground waters and mineral products. Preparation of abstracts of important cases, accompanied by drawings showing the geologic conditions upon which the decisions were made. First term (1).

280. Structural Geology. The study of special features of structural geology in the field and laboratory. First term (1).

281. Geologic Methods. The study of methods employed by the geologist in the various lines of geologic investigation. Methods used by the United States Geological Survey and by the mining companies that employ geologists. Special attention to the problems that confront an economic geologist in the investigation of coal lands, oil properties, metal mines, etc. Second term (3).

BIOLOGY

PROFESSOR HALL, MR. KREIDLER

290. Botany. An elementary course treating of the structure and classification of plants. Preparation advantageous: 292. Second term (3).

291. Forestry. Lectures, recitations and laboratory work. A brief introduction to botany, followed by lectures on dendrology and text-book work on forestry. Laboratory work devoted mainly to dendrology and the characteristics of the wood of important timber species. Field trips during the autumn to enable the student to become familiar with the trees of the region. First term (2).

Careful consideration has been given by friends of the Uni-

versity and by the Board of Trustees to the matter of forestry in connection with the conesrvation of our natural resources. It does not appear to the Trustees that the present demand for professional foresters is such as to justify the establishment of a school of forestry at the University. It does appear that the question is of such great and growing importance that the University should do its part toward calling the attention not only of its students but of the section of country reached by the influence of the University to the need of a better knowledge of the principles involved. To this end courses of lectures have been instituted to which the public is invited and special instruction is given in forestry in certain of the courses.

In furtherance and support of the cause of Forestry the University has offered free tuition scholarships to graduates of the Pennsylvania State School of Forestry at Mont Alto, to pursue, as special students at this University, courses supplementary and cognate to their studies at Mont Alto.

292. Biology. Recitations from a text-book, laboratory work and lectures on the following topics: (*a*) fundamental conceptions; life, protoplasm, the cell, etc.; (*b*) the more important biological theories; variation, heredity, evolution, etc. In the laboratory, types of the various phyla are dissected and drawings made. Fee, $3. First term (3) or (5).

293. Comparative Anatomy of Vertebrates. Text-book work and recitations on the comparative anatomy of vertebrates, with a more extended discussion of biological theories. Laboratory work consisting of the dissection of types of the several vertebrate classes. Preparation required: 292. Second term (3).

294. Vertebrate Embryology. Lectures, text-book and laboratory work. Study of living, preserved, and sectioned material demonstrating the successive stages of cleavage, gastrulation, and the formation of organs. Preparation required: 293. First term (3).

295. Sanitary Biology. Lectures, recitations, assigned reading and laboratory work. Study of bacteria; microscopical appearance, methods of staining, plate and tube culture, etc. The quantitative and qualitative bacteriological and microscopical examination of water. Fee, $3. Second term (2).

296. Bacteriology. Recitations and laboratory work. General study of bacteria. Special attention to those forms which are economically important, such as those of water, foods, dairy products, soils, etc.; the action of preservatives. Preparation advantageous: 290 or 292. Fee, $3. First term (2).

297. Advanced Bacteriology. Lectures and recitations on the study of disease, immunity and sanitation. Laboratory work on the determination of species, with a special study of the pathogenic bacteria. Opportunity is given for the independent study of special problems in practical hygiene. Preparation required: 295 or 296. Fee, $3. Second term (2).

298. Physiology. A course in normal physiology, hygiene and sanitation aiming to give that knowledge of the body and its functions which all should have. Emphasis on the application of such knowledge to personal hygiene and public sanitation. Second term (2).

HYGIENE

DR. ESTES

299. Hygiene. Lectures on methods of personal hygiene and sanitary laws. For the benefit of engineering students who may later, as engineers and explorers, be charged with the health oversight of men, suggestions are given in this course regarding the physical care and sanitary comfort of working groups.

MINING ENGINEERING

PROFESSOR ECKFELDT, ASSOCIATE PROFESSOR BARTLETT

300. Mechanical Drawing. The use of instruments. Lettering and tracing. Isometric drawing. Sketches and working drawings of simple machine parts. Blue printing. Descriptive Geometry. Projections, intersections, and developments of cylinders, prisms, cones, etc. Application to graphical solution of mining problems. Second term (2). First term (1).

301. Mining Engineering. Prospecting. Modes of occurrence of minerals. Uses of geology. Prospecting for placers, veins and beds. Magnetic prospecting. Drilling, sampling. Valuation of property. Location of claims. Patenting mining ground. Boring. Use of bore-holes. Methods: by percussion and rotation. Special methods. Shaft sinking by boring. Survey of

bore-holes. EXPLOITATION. Location of plant. Rock drilling; tools and machines. Explosives; blasting; safety regulations. Shaft and slope sinking; tunneling. Supporting excavations by timber, metal, masonry, or concrete. Systems of mining underground and at the surface. HAULAGE. Surface and underground methods. Motors and cars; wire rope, aerial tramways. Loading and unloading, storage of minerals. Transportation of workmen. Signaling. First term (4).

302. ORE DRESSING. General principles and physical properties upon which the recovery of minerals or metals from ores are based, followed by detailed study of machines and apparatus used in modern practice for coarse and fine crushing; classifying and preparation for concentration; various methods of concentration, including gravity and magnetic methods, oil flotation, etc. Application of above methods to various ores; mill schemes or flowsheets. Study of procedure followed for treatment of ores and coal in typical modern concentrating plants. Mill location, construction, arrangement of machinery, operation, and costs. Visits to mills and anthracite breakers.

ORE DRESSING LABORATORY. Experimental work and tests on ores, giving practical application of principles and processes covered. A well equipped modern laboratory gives opportunity for individual as well as class operation of the most approved machinery for the preparation of ores. Fee, $5. First term (3).

303. MINING ENGINEERING. HOISTING. Motors, ropes, attachments, receptacles. Safety appliances. Systems of hoisting. DRAINAGE. Surface water; prevention of access. Mine dams. Tunnel drainage. Mechanical drainage; water hoisting; pumping. Classes of pumps. VENTILATION. Atmosphere of mines. Pollution of air. Natural and mechanical methods of ventilation; systems. Types and efficiencies of ventilating machines. Instruments for testing air. Ventilating laws. LIGHTING. Methods employed. Safety lamps; electric lighting. Safety regulations. FIRST AID. Accidents; classes, causes. Means of prevention. Rescue work. Hygiene of mines; rules and laws. First Aid to injured. RAILROAD CONSTRUCTION. Earthwork, trackwork, trestles, bridges, railroad structures, water tanks, yards. Second term (4).

304. MINE SURVEYING. Instruments. Forms of notes. Outside work. Determination of meridian. Inside work. Con-

necting outside and inside work through shafts, slopes, or tunnels. Calculation of notes; mapping. Railroad Surveying. Preliminary and location methods; theory of curves, turnouts, etc. Care of maps. Detection of errors. Special problems. Fee, $1. Summer term at the end of Junior year, three weeks, beginning June 14, 1922.

305. Mining Engineering. Construction Materials. The use of stone, brick, concrete, metal and wood for foundations, piling, dams, reservoirs, retaining walls, mine buildings, railroads, trestles, tipples, ore bins and docks. Mine Administration. Organization, employment of labor, management, mine accounts, principles of mining. First term (3). Second term (1).

306. Oil and Gas Technology. Origin and distribution of petroleum and natural gas. General survey of the geological conditions surrounding their accumulation. Oil shales. Prospecting and mapping. Location of wells. Drilling; pumping. Special methods. Storage. Pipe lines. Tank cars. Second term (2).

307. Mining Design. The design of parts of mining plant to meet given conditions, with detailed working drawings, accompanied by estimates of material and costs. Second term (3).

308. Prospecting. Surface indications of minerals, including oil, gas and water. Geological interpretation of strata and out-crops. Prospecting on surface and underground. Boring; magnetic prospecting. Mapping. Sampling and valuation of prospects. Locating and patenting claims. This course is offered as an elective for B.A. students. First term (2).

PHYSICS

PROFESSOR MAC NUTT, ASSOCIATE PROFESSOR CHARLES, ASSISTANT PROFESSORS FRY, FRAIM AND MARTIN, MESSRS. CONCILIO, GLENTZER, CARLTON, ZINSZER

320. Elementary Mechanics. Statics. Lecture demonstrations and recitations. First term (3).

321. Elementary Mechanics. Dynamics. Heat. Lecture demonstrations and recitations. Second term (3).

322. Physical Measurements. Laboratory and lectures. Fee, $6. Second term (1).

323. Elementary Physics. Electricity and magnetism. Lecture demonstrations and recitations. First term (3).

324. Physical Laboratory. Mechanics, heat and electricity. Preparation required: 322. Fee, $6. First term (1).

325. Elementary Physics. Light and sound. Lecture demonstrations and recitations. Second term (3).

326. Physical Laboratory. Electricity, magnetism, light and sound. Preparation required: 322, 323, 324. Fee, $6. Second term (1).

327. Elementary Physics. A brief general course. Lecture demonstrations, recitations and laboratory. First term (3). Second term (3).

328. Advanced Theory of Electricity and Magnetism. Lectures and recitations. Ferro-magnetism, electro-magnetism, induced electromotive force and inductance, magnetic properties of iron, electric charge and the condenser, electric field, potential, electric oscillation and waves, electron theory, electrolysis. Pre-requisites, differential and integral calculus and course 323. First term (2).

329. Electrical Laboratory. Precise measurements. Preparation required: 322, 323, 324, 326. Fee, $6. First term (1).

330. Electrical Laboratory. Precise measurements. (Continuation of 329.) Fee, $6. Second term (1).

331. Electrical Laboratory. Advanced experimental studies and tests. (Continuation of 330.) Fee, $6. First term (1).

332. Theoretical Physics. Elective courses in the theory of heat, in the theory of electricity and magnetism, and in the theory of optics. Arrangements as to topic and as to time to be devoted to it are made for each group of students who elect Theoretical Physics. First and second terms (3) to (5).

333. Physical Research. Experimental investigations in physics to be elected by special advanced students. Arrangements as to topic and as to time to be devoted to it are made for each individual student. Fee, $6. First or second term (2) to (4).

334. Photometry and Illumination. Lectures and recitations. Illumination standards, measurements of light and of illumination, laboratory methods and devices, commercial methods and experiments, comparison of illuminants and illuminating devices, practical installations. First term (1).

335. General Physics. A course intended primarily for students taking pre-medical studies. Preparation required: 327. First term (2). Second term (2).

336. The Teaching of Physics in Secondary Schools. Principles of scientific method. A study of class room practice in neighboring schools. Text-books and methods. First term (2).

337. Telegraphy. Practice in sending and receiving the Morse and International Codes based upon Western Union and U. S. A. Signal Corps practice. First term (1). Second term (1).

ELECTRICAL ENGINEERING

PROFESSOR ESTY, ASSOCIATE PROFESSORS SEYFERT AND SCHEALER, ASSISTANT PROFESSORS BEAVER, GRUBER AND ESHBACH

351. Electrical Distribution. Systems of direct current distribution; wiring formulas and applications; installation of electrical machinery and apparatus; interior wiring, overhead and underground construction; rules and regulations of the National Board of Fire Underwriters. First term (2).

352. Dynamos and Motors. Review of principles of electricity and magnetism with special reference to their application to the dynamo. The construction, operation and control of direct current machinery; practical operation and management of dynamo machines; station equipment; cost of electrical energy; electro-magnets, magnetism of iron; characteristic curves, armature windings. Illustrative problems. Preparation required: 323, 324. Second term (3).

353. Dynamo Laboratory. Introductory course supplementing the class work of 352. Experimental studies and tests of direct current generators, motors, and appliances, for characteristics, regulation, efficiency, insulation, etc. Fee, $6. Preparation required: 323, 324. Second term (1).

354. Dynamos and Motors. An abbreviated course adapted to those students who do not continue this subject in the following year; the principles and practice of direct current engineering, including: the elementary theory, construction, operation and control of direct current generators and motors, electromagnets, solenoids, automatic starters and controllers, station equipment, storage batteries. Illustrative problems. Preparation required: 323, 324. First and second terms (2).

355. Dynamo Laboratory. Introductory course supplementing the class work of 354. Experimental studies and tests of direct current generators and motors for characteristics, regulation, efficiency, etc. Fee, $6. Preparation required: 323, 326. First and second terms (1).

356. Dynamo Laboratory. Continuation of 355 and supplementing the class work of 361 or 375. Advanced testing of direct current machines; practice in operating and testing alternating current apparatus. Fee, $6. Preparation required: 355, 354. First and second terms (1).

357. Theory of Alternating Currents. The elementary principles of alternating currents. Lectures, recitations and problem work. Preparation required: 352, 326. First term (3).

358. Dynamo Laboratory. Continuation of 353. Advanced testing of direct current machines. Fee, $6. Preparation required: 352, 353. First term (1).

359. Theory of Alternating Currents. Continuation of 357. Advanced theoretical studies of alternators, synchronous motors, and synchronous converters. Preparation required: 357. Second term (2).

360. Electrical Engineering. Application of physical and mathematical principles to the analysis and solution of problems relating to direct and alternating current circuits and apparatus; transient phenomena, use of complex quantities: non-harmonic periodic wave forms. Preparation required: 328, 357. Second term (3).

361. Electrical Engineering. A course particularly adapted to students who do not further specialize along electrical lines; systems of generation, transformation, distribution and transmission of electrical energy by direct and alternating currents; the application of electric motors to various industries; overhead and underground construction; estimates and costs. Preparation required: 354, 355. Second term (2).

362. Dynamo Laboratory. Continuation of 358. Advanced testing of direct current machines. Alternating current testing begun. Fee, $6. Preparation required: 357, 358. Second term (1).

363. Alternating Current Machinery. Study of the structural details, characteristics and operation of alternators,

alternating current motors, rotary converters and transformers; application of vectors. Preparation required: 328, 359, 360. First term (4).

364. Dynamo Testing. Lectures on the methods of testing electrical machinery and apparatus, including direct current generators, motors and motor generator sets. Special methods of testing large machines; commercial tests as carried out by the large manufacturing companies. Preparation required: 328, 357, 358. Second term (1).

365. Dynamo Testing. Continuation of 364. Lectures on testing of alternating current machinery and apparatus, including generators, motors, rotary converters, transformers, induction regulators, etc. Preparation required: 359, 364. First term (1).

366. Dynamo Laboratory. Advanced experimental studies and tests of direct and alternating current generators and motors, synchronous converters, transformers and auxiliary apparatus; measurement of power in polyphase circuits. Fee, $12. Preparation required: 359, 360, 362. First term (3).

367. Electrical Design. Application of electric, magnetic and mechanical principles to the design of electromagnetic mechanisms, direct current generators and motors; predetermination of characteristics and performance; armature windings. Lectures, recitations, problems, drafting. Preparation required: 359, 360, 362. First term (2).

368. Electric Stations. Consideration of prime movers; generating machinery, discussion of types and operation; auxilliary machinery and transformers; storage batteries and their application; switch-boards, measuring and protective devices; design and arrangement; station characteristics; substations; operation and management; visits to neighboring plants. Preparation required: 359, 362. First term (2).

369. Electrical Engineering Seminary. A weekly meeting held in the department reading room for discussion of topics from the current journals of theoretical and applied electricity. Presentation of papers on assigned topics; new inventions and discoveries critically reviewed. Preparation required: 357, 360. First term (1).

370. Electrical Design. Continuation of 367. Application of electric, magnetic and mechanical principles to the design

of alternating current machinery and apparatus; predetermination of characteristics and performance; armature windings. Lectures, recitations, problems, drafting. Preparation required: 363, 366, 367. Second term (2).

371. Electric Traction. Optional with 378. The construction, equipment and operation of different types of electric railways. The application of electric traction under steam railroad conditions; the dynamics of electric train movements; predeterminations of speed-time curves and the power required for different types of runs. Choice of car equipment; cost of construction and of operation. Testing of railway systems. Visits of inspection to power plants and required reports. Preparation required: 363, 368. Second term (3).

372. Electric Power Transmission. The long distance transmission of power by electricity for use in lighting, traction, mining and manufacturing work. Mathematical determination of line constants, regulation, interference, transients, etc. Switching and protection of circuits; metering and methods of charging for power; recent practice in design and construction of lines and systems. Preparation required: 375 or 363, 368 or 361. Second term (3).

373. Electrical Engineering Seminary. Continuation of 369. Presentation and discussion of reports on thesis work. Preparation required: 369. Second term (1).

374. Dynamo Laboratory. Continuation of 366. Advanced alternating current testing. Fee, $12. Preparation required: 363, 365, 366. Second term (2).

375. Alternating Currents. A course following course 354; the principles and practice of alternating current engineering; the theory of alternating currents with applications to alternating current generators, motors, transformers and other apparatus; systems of transmission and distribution; electric lighting. Preparation required: 354. First and second terms (2).

376. Inspection Report. During the vacation between the Junior and Senior years each student in Electrical Engineering is required to inspect some electric railway system, lighting or power plant, or other electrical installation, and prepare a written report thereon. A descriptive outline of the installation which the student proposes to inspect must be submitted

to the Professor of Electrical Engineering before July 6th, and after approval the detailed report must be handed in before September 21st. These reports should contain such calculations, photographs, drawings and plots as each individual case may require.

377. Thesis for Degree of E.E. Each candidate for the degree of Electrical Engineer is required to present a thesis upon a subject chosen by the candidate during the first term of the Senior year. The work upon which the thesis is based is done during the second term, and it consists in part of reading from references furnished by the professor in charge, and in part of independent work in theory, experimental research, or designing. Reports of progress on thesis work are required from time to time during the term. Much importance is attached to the thesis as evidence of the candidate's ability to carry out an independent investigation. Second term (3).

378. Electrical Communication. Optional with 371. A survey of the methods of electrical communication, principles of various systems of wire telegraphy, wire telephony, radio telegraphy and telephony, radio laboratory measurements, radio practice of the U. S. Signal Corps. Fee, $6. Preparation required: 357 or 375. Second term (3).

379. Radio Communication. Elementary principles of radio telegraphy and telephony for qualified men in the R. O. T. C. Given in connection with 337 in the Department of Physics, one hour a week of lectures and recitations. First and second terms (2).

CHEMISTRY

PROFESSOR ULLMANN, ASSOCIATE PROFESSORS BABASINIAN, DIEFENDERFER, CHAMBERLIN, LONG AND COBB, ASSISTANT PROFESSORS BECK, EWING, CARTER AND ANDERSON, MESSRS. BUCKLEY, WARD, BARBEHENN, EARLY, JONES, SMULL, KING

390. Elementary Chemistry. Description of the non-metallic and metallic elements and their compounds. Lectures illustrated by experiments, diagrams, working drawings and specimens from the museum. Note-books on the lectures required. First term (2).

391. Chemistry Laboratory. Experiments covering a systematic study of the chemical and physical properties of

the more important elements and their compounds. Long and Chamberlin's *Experimental General Chemistry.* Deposit, $15. First term (2).

392. CHEMISTRY LABORATORY. For B.A. students. Shorter course than course 391. Deposit, $15. First term (1).

393. CHEMISTRY. A course for students who pass the examination in Elementary Chemistry held on the first Saturday of the term. Smith's *General Chemistry for Colleges.* First term (2).

393a. CHEMISTRY LABORATORY. Experiments designed to accompany 393. Deposit, $15. First term (2).

394. CHEMISTRY. Continuation of 390 and 393. Second term (1).

395. QUALITATIVE ANALYSIS. Practical work in the qualitative laboratory, accompanied by lectures and recitations. Treadwell's *Analytical Chemistry, Vol. I.* Deposit, $25. Second term (2) or (3).

396. QUALITATIVE ANALYSIS CONFERENCE. Special consideration of science underlying qualitative analysis. Second term (1).

397. STOICHIOMETRY. Chemical problems and reactions. Long and Salisbury's *Chemical Calculations.* Second term (1).

398. ADVANCED CHEMISTRY. Lecture course, with recitations. Theories of chemistry; physical and chemical methods of determining atomic and molecular weights, thermo-chemistry, dissociation, solutions, catalysis, electrolysis, radio-activity, non-metallic elements and their compounds. Preparation required: 390 or 393, 391, 397. Mellor's *Modern Inorganic Chemistry.* First term (3).

399. ADVANCED CHEMISTRY. Lecture course, with recitations. Phase rule, solid solutions, colloid chemistry, metallic elements and their compounds. Preparation required: 398. Mellor's *Modern Inorganic Chemistry,* Gulliver's *Metallic Alloys.* Second term (3).

400. QUANTITATIVE ANALYSIS. Practical work in the quantitative laboratory, accompanied by lectures and recitations. Acidimetry, alkalimetry, chlorimetry, and the determination and analysis of simple chemical compounds and ores. Treadwell's *Analytical Chemistry, Vol. II.* Deposit, $30. First term (3).

401. Quantitative Analysis. Practical work in the quantitative laboratory. Analysis of simple chemical compounds, ores and metallurgical products. Deposit, $25. First term (3).

402. Quantitative Analysis Conference. Lecture and recitations concerning the laboratory work of 400 and 401. First term (2) or (1).

403. Quantitative Analysis. Continuation of 401. Deposit, $30. Second term (3).

403a. Quantitative Analysis. Summer course arranged for students in Metallurgy. Deposit, $40. Summer term (3).

404. Quantitative Analysis. Continuation of 400. Analysis of minerals, ores, slags, alloys, electrolytic analysis, etc. Treadwell's *Analytical Chemistry, Vol. II.* Deposit, $30. Second term (3).

405. Quantitative Analysis Conference. Lectures and recitations concerning laboratory work of 403 and 404. Second term (2) or (1).

406. Quantitative Analysis. Continuation of 404. Ores and alloys, complete analysis of iron and steel; also gas analysis, mineral water analysis, etc. Treadwell's *Analytical Chemistry, Vol. II*, Lord and Demorest's *Notes on Metallurgical Analysis.* Hempel's *Gas Analysis.* Deposit, $25. First term (2).

407. Quantitative Analysis Conference. Discussions concerning the laboratory work of 406. First term (2) or (1).

408. Organic Chemistry. Lectures and recitations. Typical compounds of carbon, their classification, general relations, and methods of preparation of important compounds. Bernthsen's *Organic Chemistry*, translated by Sudborough. First term (3).

409. Organic Chemistry Laboratory. Determinations of specific gravites, melting points, boiling points, vapor densities; qualitative and quantitative determinations of carbon, hydrogen, nitrogen, and the halogens. Preparation of pure organic compounds. Gattermann-Schober's *Practical Methods of Organic Chemistry*, Cohen's *Practical Organic Chemistry.* Deposit, $20. First term (2).

410. Organic Chemistry. Continuation of 408. Lectures and recitations. Second term (5) or (3).

411. Organic Chemistry Laboratory. Continuation of course 409. Practical methods of saturation, nitration, reduction,

diazotization, sulphonation, etc. Preparation of pure compounds. Study of the properties of dyes and other commercial products. Gattermann-Schober's *Practical Methods of Organic Chemistry*, Cohen's *Practical Organic Chemistry*. Deposit, $40. Second term (3) or (2).

412. INDUSTRIAL CHEMISTRY. Engineering fundamentals, including machinery and materials of chemical plants, transportation of gases, liquids and solids, grinding, pulverizing, screening, filtration, evaporation, distillation, etc. Laboratory work includes the application of these fundamentals, with reports on various problems of chemical engineering. Deposit, $25. First term (3).

413. ASSAYING. Lectures and laboratory practice in the furnace assay of the ores of lead, tin, gold, silver and of gold and silver bullion. Cyanidization. Calculations for slag and slag mixtures. Lodge's *Notes on Assaying*. Deposit, $30. Summer term: four weeks, beginning June 14, 1922, (3).

414. ASSAYING AND INDUSTRIAL MINERALOGY. This covers much of the ground of 413. In addition there is instruction and laboratory work in Industrial Mineralogy, embracing about seventy-five minerals and rocks. It is intended primarily for students in Chemical Engineering. Deposit, $30. Summer term, four weeks, beginning June 14, 1922, (3).

415. INDUSTRIAL CHEMISTRY. Continuation of 412. Lectures, problems and inspection trips on chemical processes and industries. Second term (3).

416. INDUSTRIAL ANALYSIS. Analysis of commercial products. Laboratory work. Allen's *Commercial Organic Chemistry*. Deposit, $10. Second term (3).

417. INDUSTRIAL ANALYSIS CONFERENCE. Lectures concerning the laboratory work of 416. Second term (1).

418. SANITARY CHEMISTRY LABORATORY. Qualitative and quantitative examination of drinking water and food-stuffs. Deposit, $15. Second term (1).

419. PHYSICAL CHEMISTRY. Lectures and recitations. Lewis' *A System of Physical Chemistry*. First term (3).

420. PHYSICAL CHEMISTRY LABORATORY. Physico-chemical measurements. Findlay's *Practical Physical Chemistry*. Deposit, $10. First term (1).

421. Physical Chemistry. Continuation of 419. Second term (2).

422. Physical Chemistry Laboratory. Continuation of 419. Deposit, $10. Second term (1).

423. Research Chemistry. Advanced stage of study or an investigation approved by the Professor of Chemistry of some novel problem, involving exhaustive laboratory and library study. Deposit, $15. First term (2) or (3).

424. Research Chemistry Laboratory. Continuation of 423. Deposit, $15. Second term (2).

425. History of Chemistry. Chronological development of the science, with assigned reading. Second term (1).

Deposits to cover breakage, chemicals, etc., are required as indicated above. The unused portion of the deposit is returned to the student.

Summer Schools. A course in Quantitative Analysis begins July 12, 1922, and continues for five weeks. The required course in Assaying and Industrial Mineralogy (414) begins June 14, 1922, and a second course may be given later. Summer courses are open to all persons prepared to take them.

SHIP CONSTRUCTION AND MARINE TRANSPORTATION

PROFESSORS FOGG AND CHAPMAN,
ASSISTANT PROFESSOR BECKER, MR. CLARK

450. Ship Construction. One recitation and one drawing periods a week. A study of the construction of modern steel ships. The class-room work is paralleled by drawing-room exercises, where the student works up a number of construction drawings based on the rules of the Registration Societies. Full treatment given to both longitudinal and transverse types of construction. First term (2).

451. Ship Construction. A continuation of course 450, taking up details of ship construction, bow and stern construction, and special types of construction. During the courses 450 and 451 the student fairs a set of ship's lines. Second term (4).

452. Naval Architecture. Displacement, stability, trim launching and strength of ships. Class room work paralleled by calculations in the drawing room. A displacement sheet

worked up, a curve of statical stability calculated by use of the integrator, and launching calculations carried out. Course illustrated by numerous practical problems. Preparation required: 147. First term (3).

453. Naval Architecture. Resistance, powering and propulsion; steering and maneuvering; and rolling of ships. A study made of the effect of size, form and coefficients on the speed and power of ships; appendage resistance, models and model tanks; powering of paralleled bodied ships; propeller design and the influence of the hull on the action of the propeller. The work in rolling takes up a mathematical investigation of the rolling of ships in still water and among waves. Preparation required: 452. Second term (4).

454. Marine Engineering. The marine power plant and the layout of machinery on shipboard. Boilers, reciprocating steam engines, turbines, combination machinery and Diesel engines: fuels, combustion, draft and draft apparatus; condensing apparatus and ship auxiliaries. Preparation required: 218. Second term (4).

455. Ship Design. Lectures and drawing-room work. In this course and course 456 each student carries through a design for assigned requirements which parallels the class-room work. In this design he works up the dimensions, coefficients, displacement, estimated weights and lines; stability under various conditions of loading; power and propeller requirements; layout of the power plant; freeboard and bulkhead subdivisions as required by law; strength calculation; and cargo handling arrangements. Lectures covering the design of boats for inland water navigation. Preparation required: 450 to 454. First term (3).

456. Ship Design. A completion of the work of course 455. Lectures covering the principles of heating, ventilation and some of the economic aspects of ship design and operation. Preparation required: 455. Second term (3).

457. Terminal Facilities. A study of the loading and unloading of ships, cranes, piers, transit sheds, warehouses and railroad facilities and the other factors involving a quick "turnaround" of a ship in port. Second term (2).

458. Summer Work in Ship Construction and Marine Transportation. During the summer following the Sophomore

and Junior years, students are required to spend at least eight weeks in a shipyard or at sea. (3).

459. Ship Operation. Second term (2).

MILITARY SCIENCE AND TACTICS

MAJOR LANG, CAPTAINS SHAMOTULSKI, BELL, BALDWIN, HOLLINGSWORTH, LIEUTENANT GRAHAM, SERGEANTS MADDEN, LAVIN, ALDERSON, BOYLE

An infantry unit of the Reserve Officers' Corps was established at Lehigh University in September, 1919. Conducted on a voluntary basis during the year 1919-1920, the unit had a membership of 313 students. A year later the Trustees and Faculty of the University made Military Science and Tactics a required subject, under the R. O. T. C. regulations, for physically fit Freshmen and Sophomores. Provision for this training is made in their schedule of study.

The enrollment in the unit for 1920-1921 was 587; in 1921-1922, 707.

The military courses contemplated under the War Department regulations consist of two years of basic work and two years of elective advanced work along specialized lines. A student taking the courses for four years becomes eligible, upon graduation, for a commission in the Officers' Reserve Corps of the United States Army. Uniform and equipment, consisting of cap, coat, shirt, breeches, leggins, rifle, belt, and bayonet, are furnished by the Government. Musical instruments are also furnished to the members of the band. Each student having in his possession any government property is required to execute a bond for $50. During the advanced course students are paid commutation of subsistence, amounting to approximately $12 a month.

470. Basic Course. Fundamental military training common to all arms of the service. Three hours a week, two theoretical and one practical. Theoretical instruction consisting of lectures, recitations, and quizes on organization, infantry drill regulations, rifle marksmanship, scouting and patrolling, physical training and military courtesy. Practical instruction given in infantry drill, target practice and ceremonies. First and second terms (1½).

470a. R. O. T. C. Basic Camp of six weeks, with report, for engineering students, except Naval Engineers (3).

471. Basic Course. Second year. Three hours a week. Fundamental military training common to all arms. Fundamentals of map reading and military sketching, military hygiene, infantry weapons, musketry, sanitation and first aid, command and leadership, and grenades. First and second terms (1½).

472. Advanced Course. Third year. Five hours a week. Field engineering, accompanying weapons, 37 mm. gun, light (Stokes) mortar, machine guns, military law and rules of land warfare, command and leadership, drill, marches, concealment and camouflage. First and second terms (3½).

472a. Summer R. O. T. C. Advanced Camp (3).

473. Advanced Course. Fourth year. Five hours a week. Infantry drill, tactics, tactical walks, war games, military history of the United States, command and leadership, pistol marksmanship, interior economy, and administration. First and second terms (3½).

Ample facilities for close order drill are afforded on Taylor Field. A twelve target, fifty and seventy-five foot, indoor range is located in the cage. A five target, fifty foot, range is located in Packer Hall basement; on the Mack Farm property is a four target outdoor range with firing points at 200, 300 and 500 yards. Intercollegiate team matches and intramural team matches are held from December 1 to May 1, both indoors and outdoors.

PHYSICAL EDUCATION

PROFESSOR REITER, ASSISTANT PROFESSOR BARTLETT, MR. KANALY

The aim of the Department of Physical Education is to insure the health and physical development of every student of the University. Exceptional facilities for accomplishing this aim are afforded in Taylor Gymnasium, field house and the two playing levels of Taylor Field.

Each student, upon entering the University, is given a physical examination by the Department and also a medical examination by the consulting physician. He receives a plotted card showing his relation to the normal student and he is advised as to postural and physical defects. A second

physical examination later is offered, to afford evidence of improved condition.

All students are required to take regular exercise under Department supervision. This requirement calls for two hours a week in the gymnasium, or participation, under the oversight of the Director, in one of the following organized sports: football, cross country running, basketball, wrestling, swimming, soccer, track, lacrosse, running, tennis and baseball. Members of the R. O. T. C. unit may substitute one hour of military drill for one of the two hours of required gymnasium.

500. Gymnasium. Class exercises in the open air, consisting of setting-up work for correct carriage. Work with dumb bells, wands, and Indian clubs to stimulate circulation, respiration, muscular action and to produce co-ordination and grace. Squad work on the heavy apparatus to develop strength in the larger muscles; recreative work in games and competitive exercises, to develop the play and combative elements. The various drills and athletic dances accompanied by music. Instruction in boxing, wrestling and swimming. The swimming course includes the various swimming strokes, fancy diving and modern methods of life saving. A competent instructor is in charge. The measure of proficiency required of every student is swimming at least the length of the pool. Voluntary classes in advanced apparatus work. Talks given to the Freshmen on personal hygiene and the physiology of exercise. First and second terms; for Freshmen, Sophomores, (½), Juniors, Seniors, Graduate Students, (1).

501. First Aid to the Injured. A course designed to give the student a practical knowledge of the most efficient methods of giving first aid to the injured. A brief resume of the important points in anatomy, followed by consideration of shock, dislocation, fractures, rabies, hemorrhage, burns, sunstroke, frost bite, electricity and lightning stroke, poisons and their antidotes, drowning, asphyxiation, railroad and mining injuries. Students required to do practical work in bandaging, applying splints and tourniquets, and to become familiar with the ordinary first aid materials and methods of transporting the injured. Second term (1).

CONFERENCE DEPARTMENT

PROFESSORS LAMBERT, PALMER, ULLMANN AND MAC NUTT

The Conference Department provides extra instruction in Mathematics, Modern Languages, Physics, and Chemistry for Freshmen and Sophomores.

Any student who wishes to clear up some difficulty in the Mathematics, Modern Languages, Physics, or Chemistry of the Freshman or Sophomore year, should consult the teachers in the Conference Department. Students may report at 7 o'clock any evening except Saturday. There is no fee for instruction in the Conference Department.

EXTENSION COURSES

The extension courses of the University are of two kinds:

1. Courses not of collegiate grade given in the Lehigh Evening School. These include courses in Mathematics, Mechanical Drawing, Blue Print Reading, Machine Design, Applied Electricity and Metallurgy.

2. Courses certified to be of collegiate grade. Below is the list of such courses offered. All courses marked "G" may be offered by graduate students toward the higher degrees; courses marked "g" may be so offered under conditions prescribed by the department offering the course, and with the express consent of the Committee on Graduate Courses. The letter "e" is used to indicate courses that are open to students not matriculated in the University.

PHILOSOPHY, PSYCHOLOGY AND EDUCATION

PROFESSOR HUGHES, ASSISTANT PROFESSOR DROWN

PHILOSOPHY. 1eg. HISTORY OF PHILOSOPHY. Leighton. (2) Evenings or Saturday.

PHILOSOPHY. 2e. THE RELIGION OF PHILOSOPHY. Plato, Spinoza, Kant, James. (2) Evenings.

PHILOSOPHY. 3e. ELEMENTARY LOGIC. Sellers. (2) Saturday A.M.

PHILOSOPHY. 4e. HISTORY OF SCIENCE. Libby. (2) Evenings.

PSYCHOLOGY. 1e. GENERAL PSYCHOLOGY. (2, 3 or 4) Afternoons.

PSYCHOLOGY. 2e. INTELLIGENCE. An introductory course in testing and developing intelligence. Dewey, Terman. (2) Evenings or Saturday.

PSYCHOLOGY. 3eg. INTELLIGENCE OF SCHOOL CHILDREN. Advanced course in tests, surveys and clinical studies. (2) Evenings or Saturdays.

PSYCHOLOGY. 4eg. SOCIAL PSYCHOLOGY. MacDougall, Wallas. (2) Evenings or Saturday.

PSYCHOLOGY. 5e. MENTAL HYGIENE. Principles of psychology and psychiatry applied to increasing efficiency and happiness of children and adults. James, Hall, White. (2) Evenings.

PSYCHOLOGY. 6e. CHILDHOOD AND YOUTH. Norsworthy and Hall. (2) Evenings.

EDUCATION. 1e. ELEMENTARY SCHOOL METHODS. (2) Evenings or afternoons.

EDUCATION. 2e. EDUCATIONAL MEASUREMENTS. The standard tests of achievement; how to use them. (2) Evenings or afternoons.

EDUCATION. 3eg. EDUCATIONAL MEASUREMENTS. Advanced course. Investigations and reports. (2, 3 or 4) Evenings, afternoons or Saturday.

EDUCATION. 4eg. THE PROJECT METHOD. Readings, reports, observation, experiment. (2 or 3) Evenings.

EDUCATION. 5eg. SECONDARY EDUCATION. Introductory course. Colvin. (2) Evenings.

EDUCATION. 6eG. SECONDARY EDUCATION. Advanced course. Inglis, Monroe, Johnston. (2, 3 or 4) Evenings.

EDUCATION. 7eg. JUNIOR HIGH SCHOOL. Briggs, Douglas, and others. (2 or 3) Evenings.

EDUCATION. 8eg. SCHOOL ADMINISTRATION. Cubberly; State (2) City (2) Evenings or Saturday.

EDUCATION. 9eG. SEMINAR IN EDUCATION. Reports and discussions. Saturday.

EDUCATION. 10e. HISTORY OF EDUCATION. Rousseau's *Athens, the Renaissance;* American Schools, schools of today and of tomorrow. (3) Saturday or evenings.

ECONOMICS, PUBLIC LAW AND HISTORY

PROFESSOR STEWART, ASSISTANT PROFESSOR MAC GREGOR

ECONOMICS. 1eg. SOCIOLOGY. Sociological and economic theory, and problems to which this theory may be applied. (2)

HISTORY. 1e. INDUSTRIAL HISTORY OF THE UNITED STATES. Bogart's *Economic History of the United States;* Cressy's *Outline of Industrial History.* (2) Saturday.

HISTORY. 2eg. POLITICAL AND SOCIAL HISTORY of Modern Europe. Lectures and discussions. Special reference to the causes of the recent war. (2) Evenings.

LATIN

PROFESSOR WRIGHT

LATIN. 1e. A course corresponding to the work of the Freshman year in college. (2), (3) or (4). Evenings or Saturday A.M.

LATIN. 2eg. Advanced course in Latin Literature, suited to graduate students. Hour to be arranged.

FRENCH

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

FRENCH. 1e. ELEMENTARY FRENCH. (3) Evenings or Saturday A.M.

FRENCH. 2e. ELEMENTARY FRENCH, continued. Reading and conversation course. (3) Evenings or Saturday A.M.

FRENCH. 3eG. RECENT FRENCH LITERATURE. Investigation and discussion of phases of French life as exemplified in French literature; rapid reading. (3) Tuesday, Thursday, Friday, 3:30 to 6 P.M.

SPANISH

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

SPANISH. 1e. ELEMENTARY SPANISH. (3) Saturday A.M., or Tuesday, Thursday, Friday, 4:30 to 6 P.M.

SPANISH. 2e. ELEMENTARY SPANISH, continued. (3) Saturday A.M., or Tuesday, Thursday and Friday, 4:30 to 6 P.M.

GERMAN

PROFESSOR PALMER, ASSISTANT PROFESSOR MORE

GERMAN. 1e. ELEMENTARY GERMAN. German Grammar and Composition. Easy German Texts. (2) Saturday A.M.

GERMAN. 2e. INTERMEDIATE GERMAN. German Prose and Poetry. Heine, Keller, Meyer, Freytag, Storm, Heyse. (3) Saturday A.M.

GERMAN. 3e. Goethe's *Faust*, Part I, Lectures and Composition; or Nineteenth Century German Drama. (3) Saturday A.M.

GERMAN. 4eG. Goethe's Dramas, or Schiller's Life and Work, or Middle High German. (3) or (5) Afternoons, 4 to 6.

GERMAN. 5e. Teachers' Course in methods of teaching, discussion of text-books, phonetics of German, advanced German grammar and syntax, advanced composition. (2) Saturdays or afternoons.

ENGLISH

PROFESSORS THAYER AND LUCH

ENGLISH. 1e. PUBLIC SPEAKING.
ENGLISH. 2e. CONTEMPORARY DRAMA.
ENGLISH. 3e. VICTORIAN LITERATURE.
ENGLISH. 4e. RHETORIC AND COMPOSITION.
ENGLISH. 5e. SHAKESPEAREAN DRAMA.

MECHANICAL DRAWING

PROFESSOR LARKIN, ASSISTANT PROFESSOR QUAST

These classes meet twice a week, commencing Monday, September 25, 1922, on the top floor of Williams Hall.

The fee for Mechanical Drawing is $5.00 for a course of 60 hours, and for Machine Design is $10.00 for a course of 40 hours.

METALLURGY

ASSOCIATE PROFESSOR ROUSH, ASSISTANT PROFESSOR BUTTS

METALLURGY. 1e. GENERAL METALLURGY. (2) Evenings.

METALLURGY. 2e. METALLURGY OF IRON AND STEEL. (2) Evenings.

GEOLOGY

PROFESSOR MILLER, ASSISTANT PROFESSOR TURNER

GEOLOGY. 1e. GENERAL GEOLOGY. Lectures, field trips and laboratory. Study of geologic processes and results. (4) Saturday P.M.

GEOLOGY. 2e. GEOLOGY OF PENNSYLVANIA. Lectures, field trips and laboratory. Geological history of the State and its bearing on economic and political development. (4) Saturday P.M.

GEOLOGY. 3e. APPLICATIONS OF GEOLOGY to the teaching of Physical Geography. Illustrated lectures; discussion of school problems. (4) Evenings.

GEOLOGY. 4eG. The graduate courses listed on pages 138 and 139 may be pursued as extension courses by qualified students.

BIOLOGY

PROFESSOR HALL, MR. KREIDLER

BIOLOGY. 1eg. GENERAL BIOLOGY. Lectures, laboratory and discussions. (2), (3), (4) Saturday P.M.

BIOLOGY. 2eg. COMPARATIVE ANATOMY. Lectures, laboratory and discussions. (2), (3), (4) Saturday P.M.

BIOLOGY. 3eg. BACTERIOLOGY AND SANITARY BIOLOGY. Lectures, laboratory and discussions. (2), (3), (4) Saturday P.M.

BIOLOGY. 4eg. EMBRYOLOGY. Lectures, laboratory and discussions. (2), (3), (4) Saturday P.M.

BIOLOGY. 5eg. The graduate course listed on page 139 may be pursued as an extension course by qualified students. Afternoons, 4 to 6, or Saturdays.

BIOLOGY. 6eg. FORESTRY. Lectures, laboratory and discussion. (3) Saturday P.M.

PHYSICS

PROFESSOR MAC NUTT, ASSOCIATE PROFESSOR CHARLES, ASSISTANT PROFESSORS FRY AND FRAIM

PHYSICS. 1e. ELEMENTARY PHYSICS. A brief general course; lectures, demonstrations, recitations and laboratory. (4) Saturday P.M.

ELECTRICAL ENGINEERING

PROFESSOR ESTY, ASSOCIATE PROFESSORS SEYFERT AND SCHEALER, ASSISTANT PROFESSORS BEAVER, GRUBER AND ESHBACH

CONSTRUCTIVE ELEMENTS OF ELECTRICAL APPARATUS. 1e. Studies of electrical machinery and appliances with the object of familiarizing the student with principles of operation, structural details, and practical uses. (2) Evenings.

ELECTROTECHNOLOGY. 2e. Review of the principles of electricity and magnetism, with special reference to their application to dynamo electric machinery; the elementary theory of direct current generators and motors; automatic starters and controllers; rates and costs; practical operation of dynamos; station equipment; storage batteries. DYNAMO LABORATORY. Experimental studies and tests of direct current generators and motors for characteristics, regulation efficiency, etc. Laboratory fee, $6, in addition to a charge of $15 for the course. (3) Evenings.

ELECTROTECHNOLOGY. 3e. Theory of alternating currents with applications to alternating current machinery and alter-

nating current systems of transmissions, distribution and utilization; electric lighting. DYNAMO LABORATORY. Experimental studies and tests of alternating current generators and motors, synchronous converters, transformers, and auxiliary apparatus; measurement of power in polyphase circuits. Laboratory fee, $6, in addition to a charge of $15 for the course. (3) Evenings.

CHEMISTRY

PROFESSOR ULLMANN, ASSOCIATE PROFESSOR BABASINIAN

CHEMISTRY. 1e. ELEMENTARY CHEMISTRY, with laboratory. (2) or (4) Laboratory fee of $10, in addition to a charge of $10 for the single and $20 for the double course. A summer course only.

CHEMISTRY. 2e. ORGANIC CHEMISTRY. (2 to 4) Fee, $25, including laboratory. (3) or (4) Afternoon.

SUMMER SESSION, 1922

A summer session of the extension courses will open Monday, July 10, 1922, and continue for six weeks. Dormitories will be available at reasonable rates, for women in the Moravian College for Women, Bethlehem, and for men at the University.

In Psychology, special attention will be paid to mental diagnosis and speech correction.

All courses in the Department of Philosophy, Psychology and Education are offered, and also the following: ENGLISH, 1e to 4e; FRENCH, 1e, 2e; METALLURGY, 1e, 2e; PHYSICS, 1e; PHYSICAL EDUCATION, gymnastics, swimming; GERMAN, 1e to 5e; GEOLOGY, 1e; CHEMISTRY, 1e.

A circular dealing with the Summer Session may be obtained by addressing the Registrar of the University.

EVENING SCHOOL OF BUSINESS ADMINISTRATION

The Lehigh University Evening School of Business Administration was organized in the fall of 1920 for business men in the vicinity of the University who desire a knowledge of the fundamental principles of the economics of business. A three-year course is offered. Instruction is given three evenings a week, from 7:40 to 9:40 o'clock, by members of the teaching staff of the College of Business Administration.

Upon completing the course a student receives a certificate of proficiency. If he later enters the College of Business Administration, his Evening School credits will be accepted on an hour for hour basis.

The subjects of the Evening School of Business Administration are as follows:

First Year

Business Law 1. Contracts and Negotiable Instruments. The principles of contract; formation of contracts; operation and discharge of contracts; sales of goods; insurance contracts; principal and agent; master and servant; negotiable instruments.

Banking and Currency. A study of the banking system of the United States, comparing it with those of the important European states, together with a study of the currency and currency problems of this country. Special emphasis upon the Federal Reserve Act.

Accounting. A study of the fundamental principles of accounting with sufficient practice work to illustrate these principles. Theories of debit and credit; single and double entry; construction of accounts; special books; distinction between capital and revenue and the problems involved; construction and analysis of financial statements; equity accounts; valuation of assets; methods and problems of depreciation. Emphasis on the economic aspects of accounting.

Economics. Lectures on economics, supplementing the other work of the school; optional.

Second Year

Business Finance (2 Years). An exposition of the essential principles of sound financing; the different forms of financial organization; stocks and bonds; sale of securities, promotion and underwriting; financial management and irregularities and mismanagement.

Law of Business Organization. A study of the various forms of business organization, as the single proprietorship, the partnership, and the corporation.

Corporation Accounting. The application of accounting principles to corporations, corporation accounts and records. The voucher system; construction and analysis of corporation statements and reports; assets of corporations and their

valuation; capital stock and the stock books; bonds and other forms of indebtedness; distribution of profits; handling surplus and reserves; sinking and other funds; liquidation of a corporation; combinations and consolidations; branch house accounting. Considerable practice work. Problems selected largely from examinations for Certified Public Accountancy.

Third Year

(Three subjects to be chosen.)

AUDITING.
MANUFACTURING ACCOUNTS.
INDUSTRIAL ADMINISTRATION.
ECONOMICS,
LAW.
INVESTMENTS.
GOVERNMENT REGULATION OF BUSINESS.
ADVERTISING.
FOREIGN TRADE.
INSURANCE.

A circular giving entrance requirements, fees and other details may be obtained by addressing the Registrar of Lehigh University.

SUMMER TERMS

Summer courses are required as indicated in the foregoing schedules of courses. Students not connected with the University may be admitted to summer courses if properly qualified.

GRADUATE COURSES

Courses leading to the degree of Master of Arts or Master of Science may, by permission of the Faculty, be pursued by any properly qualified person who has taken the Bachelor's degree or a degree in technology at any recognized college, university or technical institution. These courses require at least one year of advanced study in residence at Lehigh University in two departments (under two professors), or at least two years of such study in non-residence. Residence is construed as continuous attendance at the University and living under its jurisdiction. Permission to enroll for study in non-residence will be granted only in exceptional cases to students who possess ample facilities for study and work and usually only to students who can report periodically in person for conferences with the professors under whom they are studying.

The course of study selected must consist of at least fifteen exercises a week. Two-thirds of the work, ten hours a week, including a thesis, if required, must be chosen in one department called the major department. The work in the major department is to be selected from the list of graduate studies. About one-third of the work is to be in another department, called the minor department, and may be chosen from the list of graduate studies or from other advanced courses offered by the University. The candidate is required to satisfy each professor concerned that he is fully competent to pursue the subjects selected.

Candidates may be enrolled at any period of the college year, but preferably at the beginning of the regular terms in September and February.

The fees for instruction are $100 a year for students in residence, and $50 a year for students in non-residence, payable in advance (or as arranged with the Bursar's office). Fees for students in residence are payable in two instalments of $60 and $40 at the beginning of the first and second terms respectively. A student in residence who takes more than one year shall have returned to him a pro-rata part of his payment for the second, or other succeeding years, if he finishes in a fraction of that year. A student in non-residence shall pay for the first two years; no fee will be required for the third

year, but succeeding years, if necessary and permitted by the Faculty, shall be paid for at the rate of $50 a year. The graduation fee of $10 is required of all students.

After passing examinations in the assigned studies, presenting a satisfactory thesis as evidence of ability to do original work, if required by the professor concerned, and paying all required fees, the candidate will be recommended by the Faculty to the Trustees for the Master's degree appropriate to the course pursued.

Some of the University Extension Courses listed on page 125 are designated as graduate courses. As these are given late in the afternoon, or in the evening, or on Saturdays, they are especially adapted to teachers and others who are enrolled as graduates in non-residence.

The following graduate studies are now offered by the University:

MATHEMATICS AND ASTRONOMY

PRACTICAL ASTRONOMY

PROFESSORS THORNBURG AND OGBURN

The study of instruments and methods used in the determination of time, latitude, longitude and azimuth; practical work in the observatory, securing facility in making and reducing observations. Two terms (5).

DIFFERENTIAL EQUATIONS

PROFESSOR LAMBERT

Course in Differential Equations based on Johnson's *Differential Equations* and Byerly's *Spherical Harmonics.* Collateral reading in the University Library required. Two terms (3).

ANALYTIC MECHANICS

ASSOCIATE PROFESSOR REYNOLDS

Elementary and Advanced Rigid Dynamics; Potential Functions, based on Love's *Theoretical Mechanics;* Williamson and Tarleton's *Dynamics;* and Routh's *Dynamics.* Two terms (3).

DIFFERENTIAL GEOMETRY

ASSISTANT PROFESSOR KNEBELMAN

Parametric representation of plane and skew curves and surfaces, theory of contact, curvature, differential invariants, intrinsic equations, trajectories, equations of Césaro, curvilinear

coordinates, equations of Lamé. Representation of one plane upon another, conformal and spherical representation, equations of Gauss and Godazzi, theory of applicability. Two terms (2).

ENGLISH

ENGLISH LITERATURE

PROFESSOR THAYER

An advanced course in branches which have not formed a part of the undergraduate work of the candidate, details to be arranged after a personal conference. Two terms (5).

ANGLO-SAXON

ASSISTANT PROFESSOR MESCHTER

Anglo-Saxon poetry and prose above the grade of undergraduate work, from both the literary and the historical points of view. Two terms (5).

ENGLISH PHILOLOGY

PROFESSOR LUCH

An advanced course in the principles of Teutonic philology as applied to the origin and development of the English language. Two terms (5).

MODERN POETRY

ASSISTANT PROFESSOR MESCHTER

Poetry of the Twentieth Century, in matter, metre and diction. Present tendencies. One term (5).

SANSKRIT

PROFESSOR THAYER

Beginner's Course. Perry's *Primer.* Lanman's *Reader.* Whitney's *Grammar.* Two terms (5).

ECONOMICS AND HISTORY

POLITICAL ECONOMY

PROFESSOR STEWART

The rise and development of economic systems and economic thought; the scope and method of political economy. Patten's *Development of English Thought* and the works of Keynes, Cohn and Ingram on political economy are used. Two terms (5).

AMERICAN HISTORY

PROFESSOR STEWART

An examination of the influence of the economic development of the Union upon the legal and political theories incorporated in the Constitution. Two terms (5).

POLITICS

PROFESSOR STEWART

The history of the attempt to treat in a systematic way the problems of political organization. Pollock's *History of the Science of Politics* and Sidgwick's *Elements of Politics*. Two terms (5).

GREEK

Adanced courses, of which the following are specimens, will be arranged upon application:

HELLENISTIC GREEK

PROFESSOR GOODWIN

Gospel of St. Mark, Acts, and selected *Epistles of the New Testament*. Thayer's *Lexicon*. Blass's *Grammar of New Testament Greek*. Patristic literature. Collateral reading. Selections from Lucian. Two terms (5).

DRAMATIC POETRY

PROFESSOR GOODWIN

Several plays of Aeschylus, Sophocles, Euripides, and Aristophanes. Aristotle's *Poetics*. Collateral reading. Two terms (5).

GREEK PHILOSOPHY

PROFESSOR GOODWIN

Plato's *Republic* and other works. Aristotle, selections. Ritter and Preller's *Historia Philosophiae Graecae*. Zeller's *History of Greek Philosophy*, and other collateral reading. Two terms (5).

ELECTRICAL ENGINEERING

THEORY OF ALTERNATING CURRENTS AND ALTERNATING CURRENT MACHINERY

PROFESSOR ESTY

A course based upon the works of Arnold, Bedell and Crehore, Fleming, Steinmetz and Lawrence. Two terms (4).

ELECTRICAL DESIGN

PROFESSOR ESTY

A course consisting of predeterminations by calculation of the characteristics, regulation and performance of electrical machinery. Analysis and use of designing constants. Design of special machines. Two terms (3).

ELECTRIC TRACTION

PROFESSOR ESTY, ASSISTANT PROFESSOR ESHBACH

The development of an electric railway project. Design of station and distribution system. Operating characteristics of direct and alternating current railway motors. Predetermination of motor equipment and run curves for given schedules and traffic. Choice of system. Estimates of costs. Two terms (3).

ELECTRICAL TESTING

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT

Special experimental research in electrical engineering; tests of the magnetic properties of iron and steel; investigation of the series single-phase alternating current motor; leakage reactance of induction motors; regulation of alternators; polyphase testing; electric railway testing. Two terms (3).

RADIO COMMUNICATION

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT

The theory underlying the various sending and receiving systems, and the propagation of electromagnetic waves, combined with experimental work in connection with the department's wireless equipment. Two terms (2).

MINING ENGINEERING

METHODS OF MINING

PROFESSOR ECKFELDT

The study of methods used in a given mining region, or in the production of a given class of mineral, with respect to conditions influencing choice of method and cost. Two terms (5).

MINING PLANT

PROFESSOR ECKFELDT

The determination of the efficiency of mining machinery of given types under varying conditions. Two terms (5).

ORE DRESSING PLANT

ASSOCIATE PROFESSOR BARTLETT

The study of certain operations incident to the dressing of ores or the preparation of coal. Determination of efficiency of machines and processes. Losses in dressings. Two terms (5).

GERMAN

PROFESSOR PALMER, ASSISTANT PROFESSOR MORE

The German Drama of the Nineteenth Century. First and second terms (3).

Lessing as Dramatist and Critic. First and second terms (3).

Middle High German. Wright's *Middle High German Primer*, Bachmann's *Mittelhochdeutsches Lesebuch*, Nibelungenlied. First term (3).

Midde High German. Gudrun, Wolfram von Eschenbach, Gottfried von Strassburg, Walter von der Vogelweide. Lectures on Middle High German literature. Second term (3).

GEOLOGY

GEOLOGICAL INVESTIGATION

PROFESSOR MILLER

The investigation and study of the literature of some special geological problem. Field and laboratory work on some district; map of a limited area; an investigation of the microscopic character and general structural features of the rocks which are exposed; presentation of a thesis or dissertation embodying these results. Preparation required dependent upon the nature of the problems to be studied. Two terms (4).

ECONOMIC GEOLOGY

PROFESSOR MILLER

Advanced work in ore deposits. Study of the literature and of the theories of ore deposition, together with detailed work on the type occurrences of some of the metallic or non-metallic minerals. Thorough investigation and report on some mining district with special regard to the origin of the ores and such commercial aspects of the deposits as may depend chiefly on the geology. Preparation required: 270 or 271. Two terms (6).

PETROGRAPHY

ASSISTANT PROFESSOR TURNER

A critical study of recent advances in petrographic methods and nomenclature. Preparation of a detailed report on a selected problem. Preparation required: 266, 268, 269 and 276. Second term (3).

PHYSIOGRAPHY

PROFESSOR MILLER

The detailed study of physiographic types and processes. Conferences, reports and thesis, with work in the laboratory and field. A training in elementary physiography and general geology required as a pre-requisite. Two terms (4).

PHYSICAL CRYSTALLOGRAPHY

ASSISTANT PROFESSOR TURNER

An advanced course in the geometrical and physical properties of crystals, with special reference to the Goldschmidt methods of crystal measurement and projection. First term (4).

BIOLOGY

VERTEBRATE HISTOGENESIS AND ORGANOLOGY

PROFESSOR HALL

Advanced courses, of graduate grade, may be arranged in comparative anatomy, vertebrate embryology and bacteriology. Other courses, covering such subjects as the history of biology, genetics, etc., which do not involve laboratory work, may also be arranged. Careful following, in the laboratory, of the development of a vertebrate, tracing of the history of the germ-layers, organs and tissues. Organology dealing with the association of tissues to form organs. Preparation required: 292, 293, 294. First term (3).

PHILOSOPHY, PSYCHOLOGY AND EDUCATION

PROFESSOR HUGHES, ASSISTANT PROFESSOR DROWN

The following undergraduate courses may count toward an advanced degree provided additional work is taken in connection with them: History of Philosophy, ancient and modern, History of Education, Educational Psychology, Principles and Practice of Teaching, and Psychological Studies. More advanced courses in Psychology, Logic, Ethics and Metaphysics may be outlined to meet the needs of competent students.

The following is the course that commonly is followed by those who select Education as the major study: Educational Psychology, two year hours; School Administration, two year hours; Secondary Education, two year hours; Seminar in Education, with Thesis, four year hours. Most students in the field of Education find it convenient to avail themselves of the Extension Courses, which are listed on page 125.

GRADUATE COURSES

PROFESSOR HUGHES

History of Philosophy, advanced course. Two terms (2).

Seminar in Philosophy. Two terms (2).

Social Psychology. A. The relation to essential human needs of the several forms of culture—sport, art, the moral and religious consciousness, and the spirit of science; their origin and development. One term (2). B. Psychological measurements and mental hygiene. One term (2).

Greek Education. One term (2).

ASSISTANT PROFESSOR DROWN

Educational Measurements. Investigation and reports. One term (2).

Secondary Education. Two terms (2).

School Administration. Two terms (2).

Seminar in Education. Two terms (2).

FRENCH

LITERATURE

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

An advanced course in French Literature. The course is arranged with each candidate individually upon application. Two terms (5) or (10).

LANGUAGE

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

A. Old French. Grammar. Easier texts. Chanson de Roland. First or second term (2) or (3).

B. Old French. Reading and explanation of texts. First or second term (2) or (3).

C. Romance Philology. Sound change. Word formation. First or second term (2) or (3).

D. Romance Philology. Syntax. First or second term (2) or (3).

SPANISH

LITERATURE

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

An advanced course in Spanish Literature. First or second term (2) or (3).

LANGUAGE

PROFESSOR FOX

OLD SPANISH. Grammar. Readings. First or second term (2) or (3).

ITALIAN

PROFESSOR FOX

Dante's *Inferno*. Lectures and outside reading. First or second term (2) or (3).

CHEMISTRY

ADVANCED INDUSTRIAL CHEMISTRY

PROFESSOR ULLMANN, ASSOCIATE PROFESSOR CHAMBERLIN

Study of some industry dependent upon chemical principles, consisting of experimental and analytical work in the laboratory and study of the technical journals and other publications. Two terms (10).

ADVANCED ORGANIC CHEMISTRY

ASSOCIATE PROFESSORS BABASINIAN AND COBB

Original investigations in organic chemistry. Two terms (10).

ADVANCED ANALYTICAL CHEMISTRY

PROFESSOR ULLMANN, ASSOCIATE PROFESSOR DIEFENDERFER

Study and comparison of known methods of quantitative analysis and the development of new methods. Two terms (10).

PHYSICAL CHEMISTRY

ASSISTANT PROFESSOR EWING

Original investigations in physical chemistry. Two terms (10).

PHYSICS

THEORETICAL PHYSICS

PROFESSOR MAC NUTT, ASSOCIATE PROFESSOR CHARLES

Elective courses in the following subjects: (*a*) The Theory of Heat, based upon Preston's *Theory of Heat*, Buckingham's *Thermodynamics*, and Nernst's *Theoretical Chemistry;* (*b*)

The Theory of Electricity and Magnetism, based upon Maxwell's Treatise, J. J. Thompson's *Recent Researches*, and *Conduction of Electricity Through Gases*, Hertz's *Electric Waves*, and Starling's *Electricity and Magnetism;* (c) The Theory of Light, based upon Preston's *Theory of Light*, Drude's *Theory of Light*, Wood's *Physical Optics*, and Edser's *Light for Advanced Students*. First and second terms (3) to (5).

PHYSICAL RESEARCH

PROFESSOR MAC NUTT, ASSOCIATE PROFESSOR CHARLES

Opportunity afforded advanced students to pursue experimental investigations in physics. First and second terms (2) to (4).

CIVIL ENGINEERING

BRIDGE DESIGN

PROFESSOR FOGG

The theory of suspension and arched structures, with the preparation of general plans and estimates, and the economic comparison of different types. Two terms (4).

TESTING OF MATERIALS

PROFESSOR FOGG, ASSISTANT PROFESSOR FULLER

The properties of materials of construction, with special reference to inspection and testing. Original researches by the student in the laboratory. Detailed attention to the work on the unification of methods of testing done by the International Association for Testing Materials. Two terms (5).

RAILROAD ENGINEERING

PROFESSOR WILSON

The economic location of railroads, as influenced by probable volume of traffic and cost of operation. A course based on Wellington's treatise, with detailed discussion of special cases. Two terms (2).

SANITARY AND HYDRAULIC ENGINEERING

ASSISTANT PROFESSOR PAYROW

The designing of reservoirs, tanks, and pipe lines for water supply systems, and of sewers and other appurtenances for sewerage systems. Inspection of existing plants, with reports thereon. Two terms (4).

NAVAL ENGINEERING

ADVANCED SHIP DESIGN

PROFESSOR CHAPMAN

Advanced work in the design of cargo and passenger ships. The relation of size and speed of ships for the most economical performance in service; a study from actual layouts of the relative merits of various types of propelling machinery; subdivision and flooding calculations according to the rules of the Bulkhead Committee of the Board of Trade.

The design of special types of ships and sailing yachts. Two terms (5).

THE POWERING AND PROPULSION OF SHIPS

PROFESSOR CHAPMAN

An advanced course consisting of a study of powering and propeller data and a comparison of the work of various investigators. Two terms (2).

THE STRENGTH OF SHIPS

PROFESSORS FOGG AND CHAPMAN

Investigation of the stresses set up in a ship's structure with particular application to special types of construction. Two terms (3).

LATIN

PROFESSOR WRIGHT

An advanced course in the Latin language and literature or in one of the branches of Roman antiquities, arranged with each candidate individually on application. Two terms (5).

METALLURGY

THERMO-CHEMISTRY AND THERMODYNAMICS OF THE METALS

ASSOCIATE PROFESSOR ROUSH

A study of the melting points, vapor tensions, specific heats, and latent heats of fusion and of vaporization of the metals, from practical and theoretical viewpoints; also, of the heats of formation of compounds of the metals, and the relation of these to atomic weights and other chemical and physical properties. Lectures and laboratory work. First term (5).

THERMO-CHEMISTRY AND PHYSICS OF METALLIC ALLOYS

ASSOCIATE PROFESSOR ROUSH

A study of the physical and chemical properties of metallic alloys, their melting points, specific heats, latent heats of

fusion, heats of formation and microscopic structures. Lectures and experimental work. Second term (5).

ELECTROMETALLURGY

ASSOCIATE PROFESSOR ROUSH

A study of the conditions of deposition of metals and alloys in electrolysis, electrolytic separations, formation of metallic compounds by electrolysis, energy absorption in electrolysis. Lectures and laboratory work. First term (5).

TUITION AND OTHER FEES

The tuition fees are as follows: In the College of Engineering, $300 for the year or $180 for either term; in the College of Business Administration, $250 for the year or $150 for either term; in the College of Arts and Science, $200 for the year or $120 for either term.

The tuition for Chemistry offered in the Summer term immediately following Commencement Day is $25; for all other subjects, $30. No charge is made for such subjects to students who have paid tuition for the previous year, provided the subjects in question are a scheduled part of the technical courses they are pursuing. A graduation fee of $10 is paid by all candidates for a degree. A registration fee of $10 is paid by each student yearly.

All fees are payable at the office of the Bursar in Drown Memorial Hall. Tuition fees are payable in two instalments, on the opening day of the college year in September, and on the first day of the second term in February. The first instalment is $180, or $150, or $120, according to the course, and the second instalment is $120, or $100, or $80, according to the course. Application may be made for a return of part of the tuition fee if a student has formally withdrawn from the University after less than four weeks' attendance in either term, but the amount thus refunded will in no case exceed one-half of the last instalment paid.

Students who fail to pay tuition fees when due will be notified that their attendance at college exercises must be discontinued until payment is made.

EXPENSES

Books, stationery, and drawing instruments may be bought by students at low prices at the Supply Bureau in Drown

Memorial Hall. For work in the laboratories, materials may be obtained from the University, students paying a fee or making a deposit at the opening of the term covering the value of the materials. The amounts of these deposits are given under the detailed statements of laboratory courses in the List of Studies.

The University dormitories accommodate 171 students. The charge for single rooms is $80 a year; suites of three or four rooms rent at $100 for each occupant.

Students may obtain table board at the College Commons. The rate is $30 for thirty consecutive days. Numerous private householders in the city offer rooms and board at moderate charge.

Necessary expenses for the collegiate year, clothing and traveling not included, are estimated at $600 in addition to tuition. This includes attendance at the required summer schools.

SITE

Bethlehem is situated at the junction of the Lehigh Valley, the New Jersey Central and the Philadelphia and Reading Railroads. The University buildings are about a half-mile from the station. New York is eighty-six and Philadelphia fifty-seven miles distant.

BUILDINGS AND GROUNDS

The University occupies nineteen buildings, and its grounds cover 160 acres on the north side of South Mountain, overlooking the valley of the Lehigh River and the city of Bethlehem.

PACKER HALL

Packer Hall, completed in 1869, is four stories in height, 215 feet long. and 60 feet wide. It is built of Potsdam sandstone in the English Gothic style of architecture.

The Department of Civil Engineering occupies the greater part of the first and second floors of Packer Hall. On the first floor are a lecture room, two recitation rooms, a large drawing hall, two instrument rooms, two offices and a library room. The instrument rooms contain seventeen transits, fourteen levels, a large geodetic theodolite, two plane tables and other instruments for engineering field work. In the library room is a collection of plans of engineering structures. On the second

floor are two drawing-rooms, three recitation rooms, an instrument room, a blue-print room, and offices.

On the third and fourth floors are to be found the offices and recitation rooms of the Department of Mathematics and Astronomy.

The offices of the President, Vice-President, Secretary of the Faculty and Registrar are on the second floor of Packer Hall.

THE WILLIAM H. CHANDLER CHEMICAL LABORATORY

The Chemical and Metallurgical Laboratories are contained in a fire-proof sandstone building, 259 feet in length by 44 in width, with two wings, each 62 feet in length by 42 feet in width.

In the Chemical department there are two principal stories, a basement and a topmost story given over to the laboratory for physical chemistry. The upper floor is occupied by the quantitative and the qualitative chemical laboratories. These rooms are 22 feet in height, and are well lighted and ventilated. Laboratories for research chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a smaller lecture room, a recitation room, a chemical museum, and laboratories for organic chemistry and sanitary chemistry.

In the basement is a large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis; also rooms containing the apparatus for processes in industrial chemistry, steam engine and dynamo and motor installation, air pump for pressure and vacuum filtration, etc.

The University has recently completed an extension of the Chemical Laboratory. It is three stories high, in architectural conformity with the main building, and has inside dimensions of 60 feet by 37 feet. The equipment of these laboratories is of the most modern type, and every accessory to comfort and efficiency in expediting laboratory work is provided.

The Metallurgical department contains a lecture room; a museum of metallurgical collections; an extensive departmental library; a dark room for photographic work; a laboratory provided with a spectroscope, a simple and a polarizing microscope, two Le Chatelier and one Leitz metallographic microscopes complete with camera; a dry laboratory provided with gas and electric furnaces, with natural draught and with blast,

electric current for electrometallurgical experiments. Equipment is provided for laboratory work in metallurgy, in metallography, and particularly in electrometallurgy, consisting of gas, electric current and apparatus for various kinds of experimental work. Several new pyrometers, calorimeters, and furnaces have been added recently to the general equipment. This department is therefore equipped for the instruction of classes in metallurgy and electrometallurgy of the regular curriculum, to afford facilities to students for familiarizing themselves with the methods of measurement and research employed in metallurgy and electrometallurgy, and for conducting original investigation in these departments of science.

The Trustees of the University named this building The William H. Chandler Chemical Laboratory in recognition of Dr. Chandler's thirty-five years' service as Professor of Chemistry, 1871-1906.

THE PHYSICAL AND ELECTRICAL ENGINEERING LABORATORY

The Physical and Electrical Engineering Laboratory is 240 feet long, 44 to 56 feet wide, and four stories high. The halls and stairways, the photometer rooms, and all apparatus rooms are of fire-proof construction. The remainder of the building is of heavy mill construction.

On the first floor are the Advanced Electrical Laboratory and shops of the Physics Department, the Senior and Junior dynamo laboratories, the shop and research room of the Electrical Engineering Department, and a storage battery room belonging jointly to the Departments of Physics and Electrical Engineering.

The dynamo laboratory for Senior students in the west wing is supplied with power from a 75-kilowatt rotary converter receiving current from the University power plant through two 30 kilowatt transformers. The dynamo laboratory equipment, which is being constantly increased, now includes the following apparatus: an 18-kilowatt double current generator, two direct current motor-generator units, one Lincoln variable speed motor, a 4-kilowatt Westinghouse two-phase rotary converter, a 10-kilowatt General Electric six-phase compound rotary converter, two direct connected units consisting of 7½-kilowatt six-phase General Electric alternators driven by 15-horse power Allis-Chalmers motors, one 20-kilowatt two- (or three-) phase alternator built by the Department, a 35-kilowatt

Westinghouse single-phase alternator, a 10-kilowatt composite wound alternator driven by a 15-horse power Crocker-Wheeler motor, a pair of 3-horse power direct connected series crane motors, three motor-generator sets converting from alternating to direct current, four polyphase induction motors ranging from 2-horse power to 7½-horse power, three types of single-phase induction motors, two single-phase commutator motors, twenty-two transformers of from 1 to 15-kilowatts, including two 15-kilowatt Scott-connected transformers, a 5-kilowatt 66,000-volt testing transformer, a 6-light constant current transformer, a 30-ampere arc rectifier outfit complete, a General Electric oscillograph outfit, a Crane lecture room oscillograph, and a variety of instruments, including voltmeters, ammeters, watt-meters, rheostats, contact makers, frequency meters, dynamometers, condensers, and other apparatus.

The dynamo laboratory for Junior students on the first floor in the west wing contains the following apparatus: a 20-kilowatt Ferranti alternator driven by a direct current motor, two arc light machines, twenty arc lamps of various types, a Brackett cradle dynamometer, a Westinghouse two-phase rotary converter, a motor driven battery-booster set, several types of adjustable speed motors, and other motors for direct and alternating currents.

On the second floor are the offices of the Departments of Physics and of Electrical Engineering, two general apparatus rooms, a large laboratory room for Physics, a large dynamo laboratory for Sophomore students in Electrical Engineering, and an Electrical Engineering reading room. The dynamo laboratory for Sophomore students in the west wing is equipped with twenty-seven direct current machines of various types, dynamotors and several types of automatic starters and auxiliary apparatus. Apparatus exemplifying the operation of telegraph, telephone, and radio telegraph and telephone stations are here installed. The equipment in radio telegraphy and telephony includes a 250-foot antenna, 5-kilowatt transformer, oscillation transformer, a 3000-volt direct current generator, quenched gap, and several sets of receiving apparatus.

On the third floor are the lecture room, apparatus rooms and photometer rooms of the Department of Physics, and lecture

room, recitation rooms, apparatus room, and radio laboratory of the Department of Electrical Engineering.

On the fourth floor are recitation rooms and two large laboratory rooms of the Department of Physics.

THE W. A. WILBUR ENGINEERING LABORATORY AND POWER HOUSE

The W. A. Wilbur Engineering Laboratory was erected in 1902; in 1907 the original building was doubled in size, the addition containing the new heating and lighting plant of the University. The building is of sandstone, conforming in material to the adjacent Chemical and Physical Laboratories. It is 44 feet wide by 188 feet long, one story high in the boiler room, but with a raised engine room forming a second story at either end.

The boiler equipment of the laboratory consists of two watertube boilers rated at about 100-horse power each, one of Babcock & Wilcox type, the other of Sterling make. In the heat and light plant there are three 250-horse power Sterling boilers, with room for a fourth unit of equal or greater capacity. Each section has its own set of feed pumps and other auxiliaries, in the arrangement of which special provision has been made for easily conducting performance tests. The laboratory boilers are connected to the chimney of the old boiler house, and have also an induced draft outfit. The chimney of the newer plant is of radial brick construction, 125 feet high, and a forced draft equipment is to be installed when need for increased capacity arises.

A coal-storage yard north of the building has room for a season's supply of coal, and a system of belt-conveyers and bucket-elevator is provided for receiving coal, dumping it on storage pile, and conveying it into the boiler room as needed.

The engine room of the laboratory, 50 feet long, contains a vertical triple-expansion engine of 75-horse power, a 60-horse power compound two stage Ingersoll air compressor, a small tandem-compound yacht engine, a simple Ball engine direct connected to a 25-kilowatt Crocker-Wheeler generator, and a 5-horse power De Laval steam turbine. There is also a complete set of Westinghouse airbrake apparatus, with four freight car brakes. The airbrake pump and all the other small motors, including the feed and condenser pumps, are piped to the sur-

face condensers beneath the engine room floor. There are two large condensers of 150- and 60-horse power capacity respectively, with smaller ones for the pumps and for special experiments. Besides the various engines there is a large belt dynamometer, apparatus for testing guages, indicators, thermometers, steam calorimeters and other instruments, and for experiment on flow of steam, for testing injectors, etc. The exhaust system includes a Cochrane feed-water heater of 250-horse power capacity.

The engine room of the power house is 31 feet long, with concrete floor. The generating units now installed are of 50 and 100-kilowatt rating, and there is room for a third of larger size. Simple horizontal Ball engines are direct connected to General Electric alternating current generators, which furnish 60-cycle two-phase current at 2200 volts for transmission to the various distributing centers. An engine-driven and a motor-driven exciter, with the switchboard, complete the electrical equipment. The engines exhaust through a Cochrane heater, and the exhaust steam may be discharged directly into the low-pressure system during the heating season.

A floor space 45 feet by 70 feet in the old boiler house is now used as a laboratory. It contains a 150-horse power suction gas producer for anthracite coal and apparatus for gas-power engineering and hydraulics, and for minor thermodynamic experiments with steam.

This building bears the name of Mr. W. A. Wilbur in grateful recognition of the work he has done for Lehigh University.

WILLIAMS HALL

Williams Hall was the donation of Dr. Edward H. Williams, jr., of the Class of '75, and was so named by the Trustees of the University not only in recognition of this gift but also of Dr. Williams' long continued and important service to the University as an alumnus and as Professor of Mining and Geology.

Williams Hall is 186 feet long by 70 feet wide and covers a ground area of over 12,000 square feet. One-half of the building is devoted to the Department of Mechanical Engineering and the other half to the Departments of Geology and Biology.

In the eastern end there are recitation rooms, instructors' offices, drawing-rooms, reference library, and store-rooms of the Department of Mechanical Engineering, and in the basement rooms and apparatus are provided for laboratory work in experimental mechanics and engineering physics, such as the calibration of the measuring instruments used in Mechanical Engineering, the determination of the mechanical efficiencies of hoisting and other gear, and the testing of motors. In this section there are electric motors, a water motor, a 15-horse power centrifugal pump, hoists, blocks, jacks, and dynamometers of various kinds.

In the west end the Department of Geology has on the first floor two lecture rooms, two offices, library, mineralogical museum, and laboratory of petrology and petrography. The lecture rooms contain specimens of rocks and fossils and a collection of economic minerals and ores. The main lecture room is fitted with a stereopticon for illustrated lectures. The laboratory of petrography is provided with fifteen high-grade petrographic microscopes, and study collections of rocks and minerals. The collection of rocks contains over six thousand specimens from type regions in different parts of the world. The mineralogical museum contains many valuable collections representing all the prominent mineral localities in the world. In the basement are the mineralogical laboratory, the blowpipe analysis laboratory, a small chemical laboratory for analytical work, and a room fitted with apparatus run by a one-horse power motor for cutting thin sections of rock. On the second floor is the paleontological museum, which contains the fossil collections. On the third floor is a room fitted as an office and laboratory, containing a Goldschmidt's two-cycle goniometer and other apparatus for advanced work in crystallography.

On the third floor there are the drawing-room and an office of the Mining Department, also well-equipped blue-print and dark rooms and a photographic laboratory used jointly by the Departments of Mining and Geology.

The Department of Biology has its lecture room, office, reference library, laboratories, and store rooms on the second floor, and a large vivarium on the third floor. The laboratories of this Department are thoroughly equipped with collections, sections, microscopes and necessary appliances.

Two students' rooms, used by the Mining and Geological

Society and by the Mechanical Engineering Society, are located in the basement.

THE FRITZ ENGINEERING LABORATORY

The late John Fritz, of Bethlehem, known as the father of the steel industry in the United States, and a member of the Board of Trustees dating from the founding of the University, gave to the University the funds for the erection and thorough equipment of an engineering laboratory. The building was designed and erected in 1910 under the personal supervision of Mr. Fritz. The building is equipped with a general testing section for testing iron and steel, a cement and concrete section, and a hydraulic section. The equipment is used by the Civil Engineering Department in connection with courses in Strength of Materials, Hydraulics, and Cement. Any student in the University who has the proper preparation may receive instruction in this laboratory.

The building is of modern steel frame construction, 94 feet wide and 115 feet long, with the main central section 65 feet in height, and two side sections of lesser height. The external walls which enclose the steel frame are of cement brick lined on the inside with red brick. A traveling crane, of 10-ton capacity, operated by electricity, commands the entire central portion of the building in which the testing of large specimens is carried on.

The general testing section is equipped with an 800,000-pound Riehlé vertical screw testing machine, capable of testing columns 25 feet long or less, tensile specimens 20 feet long or less, and transverse specimens up to lengths of 30 feet; an Olsen universal testing machine of 300,000 pounds capacity; smaller machines for ordinary tension, compression, transverse and torsion tests; a cold-bend testing machine, and a small machine shop. The hydraulic section occupies the east end of the main room and is equipped with various tanks, weirs, pumps and other apparatus for studying problems in hydraulics. The cement and concrete section has a large room for the making and testing of specimens and a room for the storage of materials.

THE ECKLEY B. COXE MINING LABORATORY

The Eckley B. Coxe Mining Laboratory is a building of dressed sandstone, 100 feet long by 75 feet deep, one story high in front with a raised floor in the rear.

The main part of the building contains the Ore Dressing Laboratory, 40 feet by 70 feet; the west wing contains a chemical laboratory, an assay room, a balance room, and a sampling laboratory; the east wing contains the office, recitation room and an instrument room. There is a locker and wash room in the basement of the east wing.

The equipment for the main laboratory, most of which was made by the Allis-Chalmers Co., consists of a gyratory crusher, rolls, screens, jigs, Huntington mill, classifiers, concentrators (tables and vanner), gravity stamps, amalgamating plates, grinding pan, with the necessary apparatus, including grizzly, elevators, feeders, sand-pumps, settling tanks, dryers, and electric motors. The sampling laboratory contains a small jaw crusher, a small gyratory crusher, rolls, sample grinder, and a magnetic separator.

The machinery is driven by seven separate motors, and any one part or all of it can be operated at will, permitting experimental studies and tests of individual machines or groups of machines, or of an entire process, as occasion may require. The entire plant is thus flexible and enables combinations of processes in order to determine the best method to pursue in the treatment of ores, by coarse and fine concentration, and also in the preparation of coals.

Owing to the prominence which flotation methods have assumed in ore concentration, a special department of the main laboratory has been equipped for this work, and several types of testing machines have been installed, together with the necessary equipment of motors, air compressor, etc., for their operation.

The laboratory houses also the following equipment: large and small size Ingersoll-Rand rock drills, Stoper and Jackhammer drills, an Ingersoll-Rand pick machine for coal mining, a Water-Leyner rock drill, a Sullivan hand-power diamond drill machine, and a Temple-Ingersoll electric-air drill.

The laboratory has been named by the Trustees of the University "The Eckley B. Coxe Mining Laboratory" in memory of Eckley B. Coxe, who was universally recognized as a pioneer and a leader in the profession of mining engineering in this country, an active friend and valued Trustee of the University from its early days until his death. The Engineering and Mining Laboratories of Lehigh University, bearing the

names of John Fritz and Eckley B. Coxe, record the friendship and close association of these two great engineers in their life-time, and their active interest in Lehigh.

CHRISTMAS HALL

Christmas Hall has historic interest as the first building of Lehigh University. It was originally a church, which was purchased from the Moravian Congregation. In the earliest years of the University it contained a chapel, lecture rooms and students' dormitory. After Packer Hall was completed in 1868, Christmas Hall and Saucon Hall were utilized as students' dormitories and mess hall up to 1885. For many years thereafter Christmas Hall was used by the Departments of Latin, Greek and Modern Languages.

The building is now largely devoted to the Department of Military Science and Tactics.

The office and recitation room of the Department of Greek are on the second floor. The offices of the Secretary of the American Electrochemical Society are in the west end of this building.

SAUCON HALL

Extensive alterations to Saucon Hall were made in 1896, adapting it to the needs of the Department of English. It contains a study and a recitation room for each instructor, a lecture hall seating 200 persons, and a large room on the ground floor which has been fitted up for the use of the literary societies, with committee rooms adjoining.

COPPÉE HALL

Coppée Hall, formerly the Gymnasium, was completely renovated in 1913 to adapt it to the needs of the College of Arts and Science. On the first floor is a large lecture room, the office and recitation rooms of the Department of Economics and accounting rooms for instruction in Business Administration. On the second floor are the offices and recitation rooms of the Departments of Latin, German, Romance Languages, Philosophy and Education. The Psychological Laboratory, also situated on the second floor, is equipped for elementary instruction and experimentation in the psychology of sense and movement. On the third floor are the library and seminar room of the College of Arts and Science, also a large room for a museum and art gallery.

SAYRE OBSERVATORY

By the liberality of the late Robert H. Sayre, one of the Trustees of the University, an Astronomical Observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

The Observatory contains an equatorial telescope by Alvin Clark, of six inches clear aperture and of eight feet focus; a zenith telescope, by Blunt; a superior astronomical clock, by William Bond & Son; a meridian circle; a prismatic sextant, by Pistor and Martins; an engineer's transit and a sextant, by Buff and Buff. Students in practical astronomy receive instruction in the use of the instruments and in observation.

The land upon which the Observatory stands, consisting of seven acres adjoining the original grant, was presented to the University by the late Charles Brodhead, of Bethlehem.

Sayre Observatory Annex

Sayre Observatory Annex contains a modern zenith telescope of four and one-half inches clear aperture, equipped with electric illumination. The building and instruments were presented to the University by the late Robert H. Sayre in 1903. Observations secured with this instrument are for the purpose of investigating the Variation of Latitude.

THE PACKER MEMORIAL CHURCH

The Packer Memorial Church, in which daily chapel exercises are held, was the munificent gift of the late Mrs. Mary Packer Cummings, daughter of the founder of the University. It was built in 1887 and is one of the largest churches in the State. During 1909-10 it was thoroughly renovated; the walls were newly frescoed, new stained glass windows put in place, and electric lights installed. These improvements were made possible by the continued generosity of the donor, Mrs. Cummings.

THE UNIVERSITY LIBRARY

The Library building was erected by the founder of the University in 1877, at a cost of $100,000, as a memorial to his daughter, Mrs. Lucy Packer Linderman.

The building is semi-circular with a façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior there is a reading room 40 by 50 feet from which radiate book cases extending from floor to ceiling; two galleries afford access to the

upper cases. Shelf room is provided for one hundred and sixty thousand volumes. One hundred and fifty thousand volumes are now upon the shelves. The list of periodicals numbers about four hundred. The Library is open from 8 A.M. to 6 P.M., except on Sundays and holidays.

The free use of the Library, with the privilege of taking out books, is offered to students of every department on presentation of their registration cards. The use of the books and of the periodicals within the building is free to all persons. Resident graduates of the University have the full use of the Library on payment of three dollars annually. Persons pursuing systematic investigation in any study may be allowed the free use of the Library for a period not exceeding three months without fee. At the discretion of the Director, a deposit may be required when books are issued.

The Eckley B. Coxe Memorial Library

In memory of Eckley B. Coxe, who was for many years a Trustee of the University and who was profoundly interested in its welfare, Mrs. Coxe presented to the University his technical library, consisting of 7727 volumes, together with 3429 pamphlets. As the working library of a man who was remarkable as well for the breadth of his culture as for the extent and thoroughness of his acquaintance with the whole field of applied science, this addition to the resources of the University possesses the greatest value for all professional students.

TAYLOR HALL

Taylor Hall, the gift of Mr. Andrew Carnegie, is a commodious concrete dormitory situated in the University Park south of Packer Hall. It accommodates 137 students. There are suites of three rooms, (a study and two adjacent bed rooms,) for two occupants, and a few single rooms. The building was named Taylor Hall by Mr. Carnegie in honor of Mr. Charles L. Taylor, his former partner in business, a graduate of the University in the Class of 1876 and a Trustee of the University. The rates for the suites of rooms are $100 a year for each occupant. The single rooms are $80 a year.

PRICE HALL

Price Hall furnishes dormitory accommodation for thirty four students. It is named in honor of Dr. Henry R. Price, a

Alumnus of the University of the Class of 1870, President of the Board of Trustees.

Application for rooms in the dormitories should be filed with the Bursar.

DROWN MEMORIAL HALL

Drown Memorial Hall is a memorial to the late Thomas Messinger Drown, LL.D., president of the University from 1895 to 1904. The building was erected by his friends and the alumni of the University and is devoted to the social interests of the University students. It contains study, reading, conversation, and chess rooms, an assembly hall, and the offices of the Alumni Association, the Young Men's Christian Association, the college publications, the dramatic and musical organizations. It also accommodates the Supply Bureau, conducted by the University, the purpose of which is to furnish books, stationery and supplies to the students at reasonable prices. The profits of the Supply Bureau are applied to the upkeep of Drown Memorial Hall.

The office of the Bursar is in Drown Memorial Hall.

THE COLLEGE COMMONS

The Commons was erected in 1907 to furnish a place where students might obtain wholesome food at cost. There are accommodations for 400 students. The present rates for table board are $30 for thirty consecutive days.

TAYLOR GYMNASIUM AND FIELD HOUSE

In 1913 Mr. Charles L. Taylor, a graduate of the University of the Class of 1876 and a member of the Board of Trustees, donated to the University the funds required for the erection of a gymnasium and a field house.

Taylor Gymnasium is situated at the extreme east end of the grounds of the University, adjoining the athletic field. The building is 222 feet long by 73 feet wide. On the ground floor at the north end is located the game room, 93 by 70 feet, used for basketball and wrestling. The game-room is surrounded by a gallery for spectators. The main gymnasium floor measures 90 by 70 feet. Other rooms in Taylor Gymnasium are the offices and measuring room of the Department of Physical Education, a large trophy room, basketball and handball courts, fencing, boxing and wrestling rooms, and locker rooms with accommodations for the entire student-body.

The gymnasium is equipped with all modern appliances for recreative and corrective exercises, also with apparatus for calisthenic and other gymnastics, both for individual and for class work.

In addition to numerous hot and cold shower baths, adjoining the locker rooms is a swimming pool, 75 by 25 feet, with a depth from 4½ to 9½ feet. The capacity of the swimming pool is 95,000 gallons.

Adjoining the gymnasium and the stadium is the Taylor field house. It is two stories in height, and has dressing rooms, lockers and shower baths for visiting and Lehigh teams, and also rooms for medical attention to athletes.

TAYLOR FIELD

An athletic field of more than nine acres in area is provided by the University for the accommodation of students who participate in the various outdoor sports. The Stadium is located on the north side, or lower level, and provides football and baseball fields. It is surrounded by concrete stands having a seating capacity for more than 12,000 spectators. On the upper level there are practice fields for football, baseball, lacrosse and soccer, also a quarter mile track and a 220-yards straightaway, furnishing ample room for exercise by the entire student-body. During the winter months a wooden outdoor running track, fourteen laps to the mile, is provided.

A cage with 60 by 120 feet floor space affords facilities for rifle practice, indoor baseball, lacrosse, and track and field sports practice.

All athletic sports are under the direction and oversight of the Professor of Physical Education, who is aided by an Athletic Committee composed of alumni and students, members of the Faculty, a member of the Board of Trustees, and the President of the University.

SAYRE PARK

A development of the mountain side of the University grounds was effected through the donation to the University in 1900 of the sum of $100,000 by the children of the late Robert H. Sayre to be applied and used in the development of Sayre Park as a memorial to their father. Mr. Sayre was a Trustee of the University from its foundation in 1866 to his death in 1907. He acted for years as President of the Board

of Trustees, and as Chairman of the Executive Committee of the Board, and his services to Lehigh were constant and great.

THE ARBORETUM

The Arboretum is a tract of about eleven acres added in 1909 to the upper end of Sayre Park. It was established by a lover of Forestry and a friend of the University as a tree nursery for the purpose of furnishing illustrative specimens of American trees, and of cultivating trees and shrubs for the beautifying of the Park. All of the more important species of North American trees are to be found in the University Park and the Arboretum. Adjoining the Aboretum a tract of seven acres has been planted with a variety of indigenous trees as an exhibition growth of tree culture.

THE UNIVERSITY MUSEUMS

The University Museums include large collections illustrating various branches of Chemistry, Metallurgy, Geology, Mineralogy, Zoölogy and Archæology.

The Metallurgical Cabinet contains specimens illustrating the various processes for obtaining the more common metals.

The Zoölogical collections include the Packer collection of recent shells and the Werner collection of American birds. The latter contains over three hundred and fifty species. In most cases, in addition to the adults, specimens in different plumages as well as the nests and eggs are represented.

The Geological and Mineralogical Museums are housed in the west end of Williams Hall, and contain the Roepper and Keim mineral collections. collections of fossils, specimens of ore from mining districts, and extensive series of rocks which illustrate the type occurrences in different parts of the world.

The Cummings Archæological Cabinet has three thousand specimens and includes Dr. Stubb's collection of Indian relics, weapons and utensils.

UNIVERSITY LECTURES

From time to time during the University year, distinguished men in science, letters, art and business give lectures before the student-body.

HONORARY SCHOLARSHIP SOCIETIES

PHI BETA KAPPA. Students in the College of Arts and Science and the College of Business Administration who up to the middle of the Senior year maintain high scholarship

may be elected to membership, also a limited number of technical students whose work in philosophical, scientific, and language studies is of high grade.

TAU BETA PI. Students in the College of Engineering who up to the middle of the Junior year maintain high scholarship may be elected to membership.

SOCIETIES OF THE COLLEGE OF ENGINEERING

An adjunct of value in promoting professional spirit in the College of Engineering is furnished by the departmental societies,—volunteer organizations of students who meet monthly to present papers, to discuss engineering topics and, from time to time, to hear addresses by invited engineers and scientists of note.

The first of these organizations historically was the Chemical Society, organized in 1871. The original Engineering Society, open to all technical students of the University, was started in 1872. From 1885 to 1889 it issued quarterly numbers of *The Journal of the Engineering Society of Lehigh University*, containing contributions by members, alumni and others. Many of the papers read before this Society from 1890 to 1893 were published in the *Lehigh Quarterly* of those years.

Independent societies were formed in 1900 by students in the Departments of Civil Engineering and Mechanical Engineering. The Electrical Engineering Society, founded in 1887, was reorganized in 1901. The Mining and Geological Society began in 1904, the Metallurgical Society in 1917, and the Railroad Society and the Naval Engineering Society in 1920.

THE ARTS AND SCIENCE CLUB

The Arts and Science Club is the student society of the College of Arts and Science. It was founded in 1905, with the aim of promoting literary and cultural interests in the University. Students in all courses are eligible for membership. The programs of meetings include papers by members, discussions led by teachers in the College, and occasional talks by scholars from other institutions.

THE Y.M.C.A. OF THE UNIVERSITY

The Christian Association is a voluntary organization of the students for the promotion of the religious, moral, and social life of the University. It was organized April 18, 1890, and on October 11, 1890, united itself with the intercollegiate Young

Men's Christian Association. The movement is distinctly for and by students, all the officers, with the exception of the General Secretary, being chosen from the student-body. The General Secretary is Mr. J. Mark Frey, whose office is in Drown Memorial Hall.

PUBLIC WORSHIP

Morning prayers are held in Packer Memorial Church at 7:45 a.m. on every week day except Saturday. Attendance of students is required.

FOUNDER'S DAY

On the first Saturday of October of each year, commemorative exercises are held in honor of the founder of the University. On Saturday, October 8, 1921, the forty-second Founder's Day was celebrated. The oration of the day, by the Honorable John W. Weeks, Secretary of War, was presented by Major-General James G. Harbord, Deputy Chief of Staff.

UNIVERSITY SUNDAY

The University sermon is preached on the Sunday before University Day. The Rt. Rev. Frank Du Moulin, LL.D., Bishop Coadjutor of Ohio, was the preacher on Sunday, June 12, 1921, in the Packer Memorial Church.

HONOR SYSTEM

The Honor system is in force at Lehigh University, having been adopted by the unanimous action of the student-body.

GRADUATING THESES

Theses, when required, are accompanied by drawings and diagrams, whenever the subjects need such illustration. The originals are kept by the University, as a part of the students' record, for future reference, but copies may be retained by students, and may be published, permission being first obtained from the Faculty.

UNIVERSITY DAY

University Day is the close of the collegiate year. On this day graduation exercises are held at which an address is given by a representative of the Alumni Association, prizes and honors are awarded, and degrees are conferred.

The program of the exercises on June 14, 1921, was as follows:

MUSIC

PRAYER

ALUMNI ADDRESS

WALTER SAVAGE LANDIS, Met.E., '02, M.S., '06

ANNOUNCEMENT OF PRIZES AND HONORS

The Wilbur Scholarship of $200,

CLEMENT SOLOMON SCHIFREEN, of Catasauqua, Pa.

First in rank in the Sophomore Class.

The John B. Carson Prize of $50 for the best thesis in the Civil Engineering Department,

WALTER JOSEPH JUDSON, of Washington, D. C., and

HARRY GUSTAVE LARSON, of Limestone, N. Y., jointly.

The Alumni Prizes of $25, for first honor men in the Junior Class in various departments,

Mechanical Engineering,

ERNEST PAUL GANGEWERE, of Chattanooga, Tenn.

The Wilbur Prizes of $10 for excellence in the studies of the Sophomore year,

In Mathematics,

ROBERT GAIR PFAHLER, of Wilkes-Barre, Pa.

In Physics,

ROBERT WEBB BARRELL, JR., of St. Louis, Mo.

The Wilbur Prizes of $15 and $10, for excellence in the studies of the Freshman year,

In Mathematics,

First: ARTHUR PARSONS ROBERTS, of Englewood, N. J.

Second: MORRIS EARL BISHOP, of Bethlehem, Pa.

In English,

ARTHUR WOOD, of Providence, R. I.

In German,

WILLIAM HENRY HOMEYER, of Jersey City, N. J.

In French,

WALLACE MENGEL SCHLEICHER, of Maplewood, N. J., and

RUEL DEXTER WARRINER, of Philadelphia, Pa., jointly.

The Price Prize in Freshman Composition, $25,

WALTER CONRAD KLEIN, of Pottsville, Pa.

The William H. Chandler Chemistry Prizes, of $25 each,
Freshman Year: JOHN C. KITCHEN, JR., of Columbia, N. J.
Sophomore Year: CHARLES HECK MILLER, of Wilkes-Barre, Pa.
Junior Year: GEORGE FREDERICK ADELBERT STUTZ, JR., of Washington, D. C.
Senior Year: JOHN JAMES NESTEROWICZ, of Buffalo, N. Y.

Prize of $50 donated by W. S. Murray, E.E., '95, for Electrical Engineering Senior of highest rank,
THOMAS CLINTON HENNEBERGER, of Chambersburg, Pa.

SENIOR HONORS

College of Arts and Science,
First: MICHAEL CORNELIUS SCHRADER, of Bethlehem, Pa.
Second: BRADFORD WILLARD, of Plainfield, N. J.

College of Business Administration,
First: ALFRED EDMOND FORSTALL, JR., of Montclair, N. J.
Second: EUGENE WILLARD BURGESS, of Chicago, Ill.

College of Engineering,
Civil Engineering Course,
First: HARRY GUSTAVE LARSON, of Limestone, N. Y.
Second: EDMUND WARREN BOWDEN, of Camden, N. J.
Mechanical Engineering Course,
First: EDWARD ADOLPH COPPERSMITH, of Egypt, Pa.
Electrical Engineering Course,
First: THOMAS CLINTON HENNEBERGER, of Chambersburg, Pa.
Chemistry and Chemical Engineering Courses,
First: JOHN JAMES NESTEROWICZ, of Buffalo, N. Y.

JUNIOR HONORS

College of Business Administration,
First: CHARLES JOSIAH DUNKLE, of Harrisburg, Pa.

College of Engineering,
Civil Engineering Course,
First: EDWIN LOUIS REYNOLDS, of Bethesda, Md.
Mechanical Engineering Course,
First: ERNEST PAUL GANGEWERE, of Chattanooga, Tenn.
Chemistry and Chemical Engineering Courses,
First: GEORGE FREDERICK ADELBERT STUTZ, JR., of Washington, D. C.
Second: CHARLES FORBES SILSBY, of Washington, D. C.

Ship Construction and Marine Transportation Course,
First: ABRAHAM SCHROPP THAELER, of Nazareth, Pa.

SOPHOMORE HONORS

In Mathematics,

First: Robert Gair Pfahler, of Wilkes-Barre, Pa.
Second: Walter Merritt Kocher, of Allentown, Pa.

In Physics,

First: Clement Solomon Schifreen, of Catasauqua, Pa.
Second: Robert Gair Pfahler, of Wilkes-Barre, Pa.
Third: Robert Webb Barrell, jr., of St. Louis, Mo.

FRESHMAN HONORS

In Mathematics,

First: Arthur Parsons Roberts, of Englewood, N. J.
Second: Morris Earl Bishop, of Bethlehem, Pa.

In English,

Arthur Wood, of Providence, R. I.

In German,

William Henry Homeyer, of Jersey City, N. J.

In French,

William Mengel Schleicher, of Maplewood, N. J., and Ruel Dexter Warriner, of Philadelphia, Pa., jointly.

Degrees in course were then conferred as folows:

MASTER OF ARTS

Charles Joseph Brockman, B.A., (*Lehigh University*), Nazareth, Pa.

MASTER OF SCIENCE

Jacob Lynford Beaver, E.E., (*Lehigh University*), Bethlehem, Pa.
James Michael Burke, B.S., (*Lehigh University*), Akron, O.
Chee Kin Ho, B.E.M., (*Ohio State University*), Hong Kong, China.
Heihachi Kamura, Met.E., (*Meiji College of Technology, Japan*), Saga, Japan.
Robert Earl Martin, A.B., (*University of Indiana*), Bethlehem, Pa.
Samuel Raymond Schealer, E.E., (*Lehigh University*), Bethlehem, Pa.
Judson Gray Smull, B.S. (in Chem.), (*Lehigh University*), Bethlehem, Pa.
Philip Subkow, Ch.E., (*Lehigh University*), Bethlehem, Pa.

BACHELOR OF ARTS

Allen Jennings Barthold,	Bethlehem, Pa.
Adam Brucher, jr.,	Northampton, Pa.
Gerald Hunt Clark,	Andover, N. J.
Lloyd Wellington Fisher,	Reading, Pa.
Frank Allen Hall,	Middletown, Conn.
Luther Henry Kline,	Northampton, Pa.
Albert Bristol Maginnes,	Sharon, Mass.
Willis Jones Parker,	West Pittston, Pa.
Michael Cornelius Schrader,	Bethlehem, Pa.
Peter Francis Weiss,	Bethlehem, Pa.
Bradford Willard,	Plainfield, N. J.

BACHELOR OF SCIENCE

Henry Gaines Boynton,	New York, N. Y.
Eugene Willard Burgess,	Chicago, Ill.
George Lawton Childs,	New York, N. Y.
Raymond Austin Childs,	New York, N. Y.
Alfred Edmond Forstall, jr.,	Montclair, N. J.
James Heathcott Goodwin,	East Liverpool, O.
Ralph Hartzell,	York, Pa.
Arthur Smith Herrington,	Latrobe, Pa.
Richard Victor Huebner, B.S., (*Pennsylvania Military College*),	Allentown, Pa.
Davis Goodwin Maraspin,	Malden, Mass.
Frederick Wagner Rheinfrank,	Port Chester, N. Y.

CIVIL ENGINEER

Harry Chantler Bailey,	Crafton, Pa.
Carl Richard Berner,	Pottsville, Pa.
Lathrop Bevan,	East Orange, N. J.
Edmund Warren Bowden,	Camden, N. J.
LeRoy Fisher Christman,	Womelsdorf, Pa.
Louis Julius Dembo,	Baltimore, Md..
Harry Buttorff Dyer,	Nashville, Tenn.
Benjamin Ettelman,	Philadelphia, Pa.
Peter Anthony Feringa,	Grand Haven, Mich.
Abraham Fleischer,	Baltimore, Md.
Samuel Louis Flom,	Northampton, Pa.
Walter Joseph Judson,	Washington, D. C.
Harry Gustave Larson,	Limestone, N. Y.
Frank William Miller,	Reading, Pa.
John Anthony Norkiewicz,	Shenandoah, Pa.
John Walter Pumphrey,	Brooklyn, Md.
Charles Henry Wright,	St. Clair, Pa.
Ching-Sung Yu,	Kulangsu, Amoy, China.

MECHANICAL ENGINEER

Smie S. K. Chou,	Patung, Hupeh, China.
Edward Adolph Coppersmith,	Egypt, Pa.
Milton Max Esterson,	Baltimore, Md.

Warren Ezra Frankenfield,	Ambler, Pa.
William Starling Garrett,	Roanoke, Va.
Edwin Hutchins Jenness,	Henry, Ill.
Ellis Henry Kleckner,	Bethlehem, Pa.
Albert Jacob Miller,	Easton, Pa.
Warren Thomas Morgan,	Freeland, Pa.
Frederick Arthur Oehm,	Baltimore, Md.
Sereno Burnell Overton,	Southampton, N. Y.
Harold Reinhardt Pursel,	Danville, Pa.
William Heysham Sayre, jr.,	Glen Ridge, N. J.
Henry Hershey Steacy,	York, Pa.
Ross Raymond Thomas,	Hammonton, N. J.
Henry Ovington Wright,	Westfield, N. J.

METALLURGICAL ENGINEER

William Redmond Bingham,	Harrisburg, Pa.
Robert Charles Good,	Camp Hill, Pa.
Paul Carroll Power,	Crafton, Pa.
John Grant Powles,	Los Angeles, Cal.

ELECTROMETALLURGIST

John Herbert Alden,	Washington, D. C.
William Joseph Arner,	Allentown, Pa.
Louis Neuweiler Butz,	Allentown, Pa.
Harold Robertson Davenport,	West Pittston, Pa.
Eugene Cissell Gott, jr.,	Washington, D. C.
Elliott Hudson Hollenback,	Wyomissing, Pa.
Ralph Roth Wentz,	Allentown, Pa.

ENGINEER OF MINES

Frank Patrick Flanagan,	Roanoke, Va.
Paul Melville Frank,	Allentown, Pa.
James Kistler Mosser Huebner,	Allentown, Pa.
Tomas Rafael Leighton, C.E., (*University of Chile*),	Santiago, Chile.
Walter Stokley March, jr.,	Cynwyd, Pa.
James Willard Morgan,	Altoona, Pa.
Thomas Francis Mullady,	Brooklyn, N. Y.
Walter Frey Myers, jr.,	York, Pa.
Bryant King Rogers,	Montclair, N. J.
Carl Henry Schofer,	Reading, Pa.
William Alexander Sunderland,	Danbury, Conn.

ELECTRICAL ENGINEER

David Ezra Baver,	Shoemakersville, Pa.
Thomas Clinton Henneberger,	Chambersburg, Pa.
Samuel Ostrolenk,	Canby, Minn.
George Joseph Roche,	Baltimore, Md.
Gaspard Maurice Savaria,	Woonsocket, R. I.
John Malcolm Skillman,	Oldwick, N. J.
Henry Theodore Slabasesky,	Ashley, Pa.

Edward Lay Tinker,	West Haven, Conn.
William Kruse Wiegner,	Bethlehem, Pa.

BACHELOR OF SCIENCE (in Chemistry)

Malcolm Kee Buckley,	Allentown, Pa.
John Henry Widmyer,	Lancaster, Pa.

CHEMICAL ENGINEER

Charles Joseph Brockman, B.A., (*Lehigh University*),	Nazareth, Pa.
Edmund Claxton,	Narberth, Pa.
Hyman Goldman,	Easton, Pa.
William McLaurine Hall, jr.,	Parkersburg, W. Va.
Harold Abraham Heiligman,	Lehighton, Pa.
Vincent Christian Henrich,	Lebanon, Pa.
Walter Cornelius King,	Bethlehem, Pa.
George Russell Knerr,	Allentown, Pa.
William Wright Lewers,	Wilkes-Barre, Pa.
Harold Glenwood Locke,	Camden, N. J.
Edward Martin Loeser,	Elizabeth, N. J.
John James Nesterowicz,	Buffalo, N. Y.
Robert Swain Perry, jr.,	New York, N. Y.
Jackson Bornman Raiguel,	Jenkintown, Pa.
Monroe Jackson Rathbone, jr.,	Parkersburg, W. Va.
John J. Shipherd,	Evansville, Ind.
Harold Alexander Stelle,	Scranton, Pa.
Norman Henry Wasser,	Bethlehem, Pa.
Ralph Walton Woodring,	Bethlehem, Pa.

SCHOLARSHIPS, FELLOWSHIPS, AND PRIZES

THE WILBUR SCHOLARSHIP

The Wilbur Scholarship was founded in 1872 by the late E. P. Wilbur and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

THE HARRY S. HAINES MEMORIAL SCHOLARSHIP

Mrs. Henry S. Haines, of Savannah, Ga., established in 1889 a scholarship of the annual value of $200 as a memorial to her son, Henry Stevens Haines, M.E., a member of the Class of 1887. This scholarship is devoted to the support at Lehigh University, throughout his scholastic career, of one student in the Course of Mechanical Engineering.

THE FRED. MERCUR MEMORIAL FUND SCHOLARSHIPS

Friends of the late Frederick Mercur, of Wilkes-Barre, Pa., General Manager of the Lehigh Valley Coal Company, desiring to establish a memorial of their friendship and esteem, and to perpetuate his memory, contributed and placed in the hands of

the Trustees a fund called "The Fred. Mercur Memorial Fund." The income from this Fund, amounting to $600, is annually awarded to students of the University.

THE JOSEPH MANN PRICKITT SCHOLARSHIP

Mr. and Mrs. Cooper H. Prickitt, of Burlington, N. J., established, in April, 1919, a scholarship, to be known as the Joseph Mann Prickitt Scholarship, in memory of their son, Joseph Mann Prickitt, of the Class of 1917, who died on March 10, 1916.

This scholarship is of sufficient amount to cover expenses for tuition, fees and books. It is the expressed wish of the donors that the scholarship be awarded to graduates of the Burlington, N. J., High School on the nomination of the Principal of that school, subject to the approval of the President of the University, or in case of no nomination from that school that the award be made to deserving students from other places.

THE ECKLEY B. COXE MEMORIAL FUND

In memory of the late Eckley B. Coxe, Trustee of the University, Mrs. Coxe has established a fund, amounting to $58,350, the interest of which is used, under the direction of the Trustees of the University, and subject to such regulations as they may adopt, for the assistance of worthy students requiring financial aid.

THE FRANK WILLIAMS FUND

Frank Williams, E.M., of Johnstown, Pa., a graduate of the course in Mining and Metallurgy of the Class of 1887, who died October, 1900, bequeathed to the University the greater part of his estate, now amounting to over $140,000, to found a fund, the income of which is lent to deserving students. At present the larger part of this income is devoted to certain life tenants under Mr. Williams' will. After their death the entire income will be available for loans.

THE GEORGE D. CALLENDER FELLOWSHIP

The George D. Callender Fellowship for the promotion of research in chemistry, established in 1919, is a gift of $1500 annually by an anonymous friend of the late George D. Callender, a chemist, who died in Chicago in 1914 while associated with the donor of the scholarship. Mr. Callender was a native

of Linlithgow, Scotland, and was graduated from the chemistry department of Glasgow University.

WILBUR PRIZES

A fund was established by the late E. P. Wilbur for distribution in prizes as the Faculty shall determine. This fund yields an annual income of $100.

THE PRICE PRIZE FOR ENGLISH COMPOSITION

Dr. Henry R. Price, an alumnus and Trustee of the University, established in 1898 an annual prize of the value of $25, to be awarded in June to that member of the Freshman Class who shall write the best essay on a topic in English Literature assigned by the head of the Department of English not later than the beginning of the second term in each year. Special stress will be laid upon clearness of thought and force of expression. Students must signify in writing their intention of competing not later than the first of April.

The subject for the prize essay in June, 1922, will be: "John P. Kennedy's Literary Works and his Relations with Poe." The subject in 1923 will be: "Irving's Works, the Spanish Group."

THE JOHN B. CARSON PRIZE

An annual prize of $50 was established in 1909 by Mrs. Helen C. Turner, of Philadelphia, Pa., in memory of her father, John B. Carson, whose son, James D. Carson, was a graduate of the Civil Engineering Department of Lehigh University in 1876. It is awarded for the best thesis in the Civil Engineering Department.

WILLIAM H. CHANDLER PRIZES IN CHEMISTRY

Four annual prizes in chemistry of $25 each were established in 1920 by the gift of Mrs. Mary E. Chandler, of Bethlehem, Pa., widow of Dr. William H. Chandler, who was Professor of Chemistry in Lehigh University from 1871 until his death in 1906. In memory of Dr. Chandler the Faculty named the prizes "The William H. Chandler Prizes in Chemistry." Awards are made at the commencement exercises in June to the four members of the Freshman, Sophomore, Junior and Senior classes deemed by the Faculty worthy to receive them.

THE ELECTRICAL ENGINEERING PRIZE

An annual prize of $25, established by an anonymous graduate of the Electrical Engineering course, is awarded to the member

of the graduating class presenting the best thesis in Electrical Engineering.

THE ALUMNI ASSOCIATION

The Alumni Association, which has been in existence since 1876, was incorporated in 1917 under the name The Alumni Assoiciation of the Lehigh University, Inc. The Alumni Secretary, who devotes all of his time to Association affairs, is Walter R. Okeson, '96, whose offices are in Drown Memorial Hall. Mr. Okeson edits the *Lehigh Alumni Bulletin*, a news publication published monthly from October to June, inclusive, and the *Alumni and Student List*. An appointment bureau is maintained by the Association.

The officers of the Alumni Association for 1921-22 are:

President, Aubrey Weymouth, '94, of New York, N. Y.
Vice-President, Charles J. O'Neill, '93, of Washington, D. C.
Vice-President, Bernard T. Converse, '99, of Philadelphia, Pa.
Treasurer, Alan C. Dodson, '00, of Bethlehem, Pa.
Secretary, Walter R. Okeson, '96, of Bethlehem, Pa.
Archivist, Preston A. Lambert, '83, of Bethlehem, Pa.

Honorary Alumni Trustees: Henry H. Scovil, '00, of New York, N. Y.; Homer D. Williams, '87, of Pittsburgh, Pa.; William C. Dickerman, '96, of New York, N. Y.; and Charles D. Marshall, '88, of Pittsburgh, Pa.

The following are the local alumni clubs: New York Lehigh Club, Philadelphia Lehigh Club, Pittsburgh Lehigh Club, Chicago Lehigh Club, Washington Lehigh Club, Detroit Lehigh Club, Northeastern Pennsylvania Lehigh Club (Scranton and Wilkes-Barre, Pa.), Maryland Lehigh Club (Baltimore, Md.), Lehigh Club of New England (Boston, Mass.), Intermountain Lehigh Club (Salt Lake City, Utah), Lehigh Club of Central Pennsylvania (Harrisburg, Pa.), Lehigh Club of Northern New York (Schenectady, N. Y.), Lehigh Club of Northern Ohio (Cleveland, O.), Lehigh Club of Southern New England (Hartford, Conn.), Lehigh Club of Western New York (Buffalo, N. Y.), Southern Anthracite Lehigh Club (Pottsville, Pa.), Southwestern Lehigh Club (St. Louis, Mo.), Lehigh Home Club (Bethlehem, Pa.), Lehigh Club of China (Wuchang, China), Lehigh Club of Cuba (Havana, Cuba).

ALUMNI PRIZES

By a resolution of the Alumni Association of September 21, 1900, the Alumni Scholarship Fund, which was originally designed to help poor students, was with the consent of the contributors diverted from this purpose and the income devoted to prizes to members of the Junior Class. In June, 1922, two prizes of $25 each will be awarded to the first honor men of the course in Electrical Engineering and of the courses in Chemistry and Chemical Engineering. In subsequent years the prizes will be awarded to the first honor men of the other technical courses in turn.

ALUMNI PRIZES FOR ORATORY

The Alumni Association of Lehigh University established in 1882 annual prizes for excellence in oratory, amounting to $50.

Regulations

1. The contest shall be held on the 22nd day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second prize of $15, and a third prize of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the orations shall be announced at the beginning of the first term of every year, and upon one of these each competitor shall write an oration not to exceed 1200 words, taking about eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do—should they be sufficient in number—the best six shall be chosen and their envelopes opened. The others shall be returned to the addresses given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors whose orations shall have been approved, and the awards shall be made by a majority of these judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

The annual contest in Oratory for the Annual Prizes was held on February 22, 1921, with the following competitors:

Arthur Rhea Little, of Petersburg, Pa.

Adolph Theodore Prigohzy, of Brooklyn, N. Y.

Walter Louis Shearer, of Washington, D. C.

Charles Russell Wolfe, of Asbury Park, N. J.

The first prize was awarded to Mr. Prigohzy, the second to Mr. Little, the third to Mr. Wolfe, and a fourth special prize to Mr. Shearer.

The judges were Herbert J. Hartzog, '04; Rev. Henry I. Stahr, and Robert S. Taylor, '95.

WILLIAMS PRIZES IN ENGLISH

Professor Edward H. Williams, jr., an alumnus of the University of the Class of 1875, established in February, 1900, prizes amounting annually to $335 for excellence in English Composition and Oratory. The conditions of the endowment are as follows:

Sophomore Composition Prizes

1. At the beginning of each term the Sophomore Class shall be divided into two sections alphabetically and to that student in each section who, at the end of a term, and of each term, shall receive the highest rank in English Composition during that term shall be awarded the "First Sophomore Composition Prize" of ten dollars, and to that student in each section as aforesaid who shall receive the next highest rank in the same subject shall be awarded the "Second Sophomore Composition Prize" of five dollars. In each year there will be offered four first and four second prizes—a total of sixty dollars.

If more than one student shall receive the highest rank in any section, the amount of the two prizes shall be added together and the sum—fifteen dollars—shall be equally divided between them, and no second prize shall be offered in that section. If more than one student shall receive the next highest rank in any section when there is but one contestant for the first prize, the second prize shall be equally divided between the two having the second rank.

Senior Premiums

2. The Faculty shall publish within one month of the end of the University year a list of subjects for dissertations, selected from English Literature and Economics, entitled Subjects for Senior Premiums. To this list shall be appended a date near the first of January following—to be determined upon by the Faculty—when the contest shall be declared closed and the dissertations shall become due.

From the above list any member of the Senior Class may select a subject and write thereon a dissertation, whose length shall be prescribed by the Faculty, and shall send the same anonymously, but

marked for identification, as the Faculty may direct, to the Secretary of the Faculty before the date aforesaid.

The Faculty, or its committee, shall meet on the above date and at subsequent adjourned meetings, and, first, having determined upon a standard of excellence which each and all dissertations must reach in order to be admitted to the following competition, shall examine the dissertations submitted to them and admit those which reach the above standard. In case none are up to the standard, and are admitted they shall declare the contest closed for that year, and no prizes shall be awarded.

If one or more dissertions are admitted as aforesaid, the Faculty, or its committee, shall arrange them in the order of their literary merit and soundness of their reasoning, and the six highest in this arrangement shall be retained and all others returned as directed by the writers, who shall remain unknown. The names of the successful writers shall be ascertained and they shall be required to recast their dissertations in the form of an oration, and to speak the same in public at such time during the Commencement Week as the Faculty shall determine.

The Faculty, or its committee, shall be the judges of excellence in the speaking, and shall award to that Senior student who shall speak his oration in the best manner, the Senior Gold Medal, of the value of one hundred dollars, or, at his option, one hundred dollars in gold. They shall award to the other five speakers the five Senior Premiums of ten dollars each.

Graduate Prize

3. At the end of the University year, during Commencement Week, the Faculty shall publish a second list of subjects for theses selected from English Literature, Economics, Mental and Moral Science, and similar subjects which require thought and application, and which must be of such a character that their mastery shall be accomplished only through considerable research and study.

From this list any member of the class just graduating; the Senior Class of the coming University year; a graduate of one year's standing whether in or out of residence, and a graduate of any class who may be, during the coming year, in actual residence and taking post-graduate work in the University, may select a subject and write thereon a thesis of not less than five thousand words and send the same to the Secretary of the Faculty, anonymously, but marked for identification as the Faculty may designate, before the date, which the Faculty shall select within one month before the next Commencement, and which date must appear on the above list.

The Faculty, or its committee, shall meet on this date, and at adjourned meetings thereafter, and, having first established a standard of excellence, which must, first, be a high one, and second, shall require on the part of the competitor ability in the plan, development, argument, and conclusion of the work, as well as literary merit in its composition and presentation, shall admit to the following competition only those who fully attain to the above required standard.

If none of the theses submitted shall have attained to the standard aforesaid, the competition shall be declared closed and the prize shall not be awarded.

To the author of that thesis which shall have been admitted to the competition, and which shall have been declared of the highest excellence, the Graduate Prize of one hundred and twenty-five dollars shall be awarded and presented on Commencement Day with the other prizes and awards of that day.

The successful thesis shall be the property of the University, but the author shall be allowed to retain one copy. Publication of the thesis by the author will only be permitted by vote of the Faculty. Such publication must, however, be entitled Graduate Prize Thesis of the Lehigh University.

The winner of a prize shall not be allowed to compete again.

Professor Williams has directed that the income derived from the endowment for the Williams Prizes shall be applied and used as follows:

1. All portions of said income remaining after the payment of all prizes awarded in any one year, shall be invested and added to the principal of said endowment.

2. If any prize shall, for any reason, be not awarded in any year, the sum thus unpaid shall be invested and added to the said principal.

3. If for any reason the amount of the income from said endowment shall fall below the total sum necessary to pay said prizes, the amounts of the individual prizes shall be proportionally reduced till their sum shall be equal to three-fourths of the said reduced income, and this three-fourths shall be used to pay them; the remaining one-fourth is to be invested and added to the said principal.

4. This investment of residues, as above said, shall continue till the principal of said endowment shall be sufficiently large to furnish an income at two per cent. interest, which will be sufficient to pay all said prizes now established.

5. When said principal shall be large enough to furnish the necessary sum to defray the said prizes, as stated in No. 4, the surplus income remaining after paying all the prizes awarded during the year shall be used by the President of the University to encourage oratory, debate, or any other object decided upon by the Faculty.

THE FRAZIER AND RINGER MEMORIAL FUND

This is a fund for the medical and surgical care of needy students, established in memory of Benjamin West Frazier, A.M., Sc.D., formerly Professor of Mineralogy and Metallurgy, and Severin Ringer, U.J.D., formerly Professor of Modern Languages and Literatures and of History, each of whom faithfully served Lehigh University for one-third of a century. The fund was started February 12, 1906, by the donation of $13,000 by the late Robert H. Sayre. It is the hope and expectation of the friends of the University that this fund may, by other donations, be increased in time to amount to a sum sufficient to insure free medical and surgical attendance to all students of the University requiring such aid.

STUDENTS

B.A.—Bachelor of Arts.
Bus.—Business Administration.
C.E.—Civil Engineering.
Ch.E.—Chemical Engineering.
Chem.—Chemistry.
E.E.—Electrical Engineering.
E.M.—Mining Engineering.
M.E.—Mechanical Engineering.
Met.—Metallurgy.
N.E.—Ship Construction and Marine Transportation.

The names in the following lists include all the students who have registered and attended recitations at the University for the current year.

GRADUATE STUDENTS

	For Degree	Residence
Anderson, Harold Victor, B.Ch.E., (*University of Michigan*)	M.S.,	Bethlehem.
Anderson, Rachel Evans, A.B., (*Wellesley College*)	M.S.,	Easton.
Arnold, Herbert Franklin, A.B., (*Franklin and Marshall College*)	M.A.,	Easton.
Barbehenn, John Berthold, B.S., (*Pennsylvania College*)	M.S.,	Bethlehem.
Buck, Leonard Jerome, E.M., (*Lehigh University*)	M.S.,	Bethlehem.
Carroll, Clara, B.A., (*Moravian College for Women*)	M.A.,	Bethlehem.
Carter, Wayne Hanley, B.S. (in Chem.), (*Lehigh University*)	M.S.,	Bethlehem.
Concilio, August, E.E., (*Lehigh University*)	M.S.,	Bethlehem.
Crow, Mary M., B.A., (*Moravian College for Women*)	M.A.,	Bethlehem.
Curtis, George Bartlett, A.B., B.S., (*Wesleyan University*)	M.A.,	Bethlehem.
Everhart, William Alfred, A.B., (*Miami University*)	M.S.,	Granville, O.
Farber, Hobart Amory, B.A., (*Lehigh University*)	M.A.,	Northampton.
Fegely, Solon J., A.B., (*Lafayette College*)	M.S.,	Allentown.
Fetherolf, Martin D., A.B., (*Muhlenberg College*)	M.A.,	Allentown.
Frankenfield, Ira M., B.S., (*Muhlenberg College*)	M.S.,	Coopersburg.

Frankenfield, M. L., B.S., (*Muhlenberg College*) M.S., Allentown.

Glasier, J. Arthur, B.D., (*General Theological Seminary*) M.A., Bethlehem.

Gruber, Howard Dietrich, E.E., (*Lehigh University*) M.S., Bethlehem.

Haussmann, Alfred Carl, B.A., (*Lehigh University*) M.A., Bethlehem.

Glentzer, Kenneth V., B.S., (*University of Indiana*) M.S., Bethlehem.

Hess, Mary Lucetta, A.B., (*Allentown College for Women*) M.A., Hellertown.

Higgins, Emerson Corson, jr., B.S., (*Lehigh University*) M.S., Tulsa, Okla.

Hofford, Hilda Naomi, B.A., (*Moravian College for Women*) M.A., Allentown.

Huebner, Richard Victor, B.S., (*Lehigh University*) M.S., Allentown.

Jacobs, Homer Miller, Ph.B., (*Lafayette College*) M.A., Easton.

Jones, Ernest Evans, B.S., M.S. (in Chem.), *Johns Hopkins University, University of Chicago*) M.S., Bethlehem.

Karsch, Carl Henry, A.B., (*University of Pennsylvania*) M.A., Allentown.

King, Walter Cornelius, Ch.E., (*Lehigh University*) M.S., Bethlehem.

Kreidler, William Alfred, B.S., (*Lehigh University*) M.S., Bethlehem.

Leaman, Ruth A., Ph.B., (*Dickinson College*) M.A., Allentown.

McCullough, Henry Rath, A.B., (*Muhlenberg College*) M.A., Allentown.

Nordenholt, George Fred, M.E., (*Lehigh University*) M.S., Bethlehem.

Rau, Henry Brunner, B.S., (*Moravian College*) M.S., Bethlehem.

Ringleben, August A., A.B., (*Ursinus College*) M.A., Hazleton.

Roberts, J. C., A.B., (*Colgate University*) M.A., Allentown.

Roche, George Joseph, E.E., (*Lehigh University*) M.S., Baltimore, Md.

Shedd, Thomas C., S.B., (*Brown University*) M.S., Phoenixville.

Smith, Matthew John Adam, B.S., (*Franklin and Marshall College*)	M.S.,	Coopersburg.
Strunk, Elvira M., B.S., (*Albright College*)	M.S.,	Changsha, Hunan, China.
Ward, Arthur Thomas, El.Met., (*Lehigh University*)	M.S.,	Bellefonte.
Wetherhold, Mark Andrew, B.S., (*Muhlenberg College*)	M.S.,	Allentown.
Wetherhold, Ralph Vitilas, B.S., (*Muhlenberg College*)	M.S.,	Allentown.
Yeager, Howard James, AB., (*Franklin and Marshall College*)	M.A.,	Emaus.
Zell, Harry Allen, A.B., (*Franklin and Marshall College*)	M.A.,	Bethlehem.
Zerfass, Elizabeth, A.B., (*Randolph-Macon Women's College*)	M.A.,	Phillipsburg, N. J.
Ziegenfuss, Warren Allen, A.B., (*Muhlenberg College*)	M.A.,	Allentown.
Zimmerman, Edward W., B.S., (*Muhlenberg College*)	M.S.,	Allentown.

Bunn, Howard Stolpp, B.A., (*Lehigh University*)	Ch.E.,	Elkins Park.
Elguin, Agustin Nazario, C.E., (*University of Chile*)	E.M.,	Santiago, Chile.
Lloyd, Francis James, jr., B.A., (*St. John's College*)	C.E.,	Pocomoke City, Md.
Marsh, Harry Harrison, jr., A.B., (*Marietta College*)	E.E.,	Wheeling, W. Va.
Tait, Watson Fergus, jr., A.B., (*Marietta College*)	E.E.,	Parkersburg, W. Va.
Dougherty, James Gwynne, El.Met., (*Lehigh University*)	Spl. E.M.,	Beaver.
Man, Shu Sing, B.S., (*University of Hongkong*)	Spl. E.E.,	Canton, China.

SENIOR CLASS

Class of 1922

	Course	Residence
Allen, Roy Dawson,	M.E.,	Belvidere, N. J.
Alrich, John Duffield,	E.E.,	Bethlehem.
Bachman, Wilbur Geo. Tripple,	Bus.,	Allentown.
Bailey, Fred Elliott,	N.E.,	Cazenovia, N. Y.
Beatty, Seth Keeney,	Bus.,	Wilkes-Barre.
Beeckel, Hermann Charles,	E.M.,	Philadelphia.
Benz, Paul Frederick,	Ch.E.,	Haledon, N. J.
Bertolet, John Lorah,	Ch.E.,	Reading.
Bobbin, Raymond Joseph,	Bus.,	Shenandoah.
Boland, William Henry,	M.E.,	Westboro, Mass.
Boltz, Joseph Light,	N.E.,	Lebanon.
Bowler, William Lloyd,	M.E.,	Glenside.
Bowman, Henry Tregellas,	M.E.,	Schuylkill Haven.
Bowman, Nelson Blair,	E.M.,	Brownsville.
Bowman, Paul Emil,	Ch.E.,	Schuylkill Haven.
Brewer, Warren,	N.E.,	Newton Center, Mass.
Brugmann, William Hugh,	Met.,	Rutland, Vt.
Brumbaugh, Granville Martin,	E.E.,	Washington, D. C.
Brunstein, Maurice,	Ch.E.,	Atlantic City, N. J.
Bush, Donald Moyer,	Ch.E.,	Bethlehem.
Carey, James Stark,	Ch.E.,	Harrisburg.
Carpenter, Clinton Grier,	Ch.E.,	Brooklyn, N. Y.
Carroll, Henry,	M.E.,	Bethlehem.
Chen, Tsung-Fa,	E.M.,	Changsha, China.
Christman, Frederick Mertz,	Ch.E.,	Reading.
Clark, Richard James,	Ch.E.,	Bethlehem.
Cohen, Aaron Jacob,	C.E.,	Trenton, N. J.
Coleman, Lee Heicher,	M.E.,	Steelton.
Connell, Charles Augustus,	M.E.,	Plattsburg, N. Y.
Cottrell, Samuel, jr.,	Ch.E.,	Takoma Park, D. C.
Craig, Colgate,	Ch.E.,	Montclair, N. J.
Crawford, James Coalter, jr.,	E.M.,	Mount Vernon, N. Y.
Culler, Roy Lester,	M.E.,	Mechanicsburg.
Daniels, Elliott Foster,	E.E.,	Jersey City, N. J.
Davis, Guild Darwin,	M.E.,	East Orange, N. J.
Day, Harrie Lyon,	Met.,	Ogdensburg, N. Y.
Deats, Charles Taylor,	E.E.,	Flemington, N. J.

DeTurk, Elmer Francis,	E.E.,	Reading.
Dimmig, Daniel Benjamin,	E.M.,	East Greenville.
Doan, William Douglas,	E.M.,	Lansdale.
Donovan, William Michael,	C.E.,	Philadelphia.
Downes, Kenneth McIntire,	Met.,	Harrisburg.
Downing, Edmond Joseph,	C.E.,	Scranton.
Drew, Leslie Lungren,	Bus.,	Asbury Park, N. J.
Dunkle, Charles Josiah,	Bus.,	Harrisburg.
Dvorschak, Ambrose Edward,	B.A.,	Drifton.
Eisenhard, Ray Long,	Met.,	Allentown.
Enslin, Everett Morgan,	N.E.,	Wilkes-Barre.
Ewing, George Newlin,	Met.,	Philadelphia.
Farrington, James Royce,	C.E.,	Annandale, N. J.
Foote, Marshall Hanford,	Bus.,	South Norwalk, Conn.
Frain, Jacob Frank,	C.E.,	Williamsport.
Frankel, Harry,	B.A.,	Wilmington, Del.
Fresoli, Michael,	B.A.,	Bethlehem.
Gaiser, George Lincoln,	C.E.,	Newark, N. J.
Gangewere, Ernest Paul,	M.E.,	Chattanooga, Tenn.
Gerber, William Eugene,	Ch.E.,	York.
Gerlach, Jacob Aaron,	M.E.,	Easton.
Gillespie, Elwood David,	Ch.E.,	Catasauqua.
Glasmire, Frederick Wanner,	Ch.E.,	Bethlehem.
Goldcamp, Cyril Finton,	Ch.E.,	Ironton, O.
Gonzales, Eduardo,	M.E.,	Torreon, Coah, Mexico.
Gooding, Charles Pennypacker,	B.A.,	Wilmington, Del.
Green, David,	N.E.,	Atlantic City, N. J.
Greenall, Charles Huntington,	M.E.,	Allentown.
Greene, Omar Vivien,	Met.,	Yonkers, N. Y.
Gross, Abraham Albert,	Ch.E.,	Harrisburg.
Gulick, Wilson McKee,	E.M.,	Orange, N. J.
Handwerk, Erwin Casper,	E.M.,	Slatedale.
Hartshorne, Alfred Cope,	N.E.,	Phoenixville.
Herman, Arthur Louis,	Met.,	Bethlehem.
Hicks, Robert C., jr.,	E.E.,	Philadelphia.
Hindry, Walter Fitz James,	Ch.E.,	St. Augustine, Fla.
Hoch, Albert Jackson,	Met.,	Reading.
Hocker, John Stanley,	Met.,	Middletown.
Horine, John Winebrenner, jr.,	E.E.,	Columbia, S. C.
Huang, Shou-Chuan,	E.M.,	Kaiping, Chihli, China
Huber, Francis Christian,	Ch.E.,	New York, N. Y.

Huffman, Francis Miller,	Met.,	Bethlehem.
Hughes, Rupert De Armond,	Ch.E.,	Montclair, N. J.
Ide, Clinton H.,	E.E.,	Harvey's Lake.
Israel, Fielder,	Ch.E.,	Laurel, Md.
Jacobs, Frank Aaron,	Ch.E.,	Bethlehem.
Jacobs, Mahlon Kemmerer,	E.M.,	Philadelphia.
Jagels, Charles John Henry,	B.A.,	New York, N. Y.
Jefferson, Moncrief Ostrander,	N.E.,	Riverhead, N. Y.
Job, James Robert,	C.E.,	Nanticoke.
Kahn, Noah Abraham,	Ch.E.,	Bethlehem.
Keeley, Martin Jerome,	Bus.,	Jersey City, N. J.
Keenan, Raymond Anthony,	Met.,	New Kensington.
Kehler, Lloyd Benjamin,	M.E.,	Shamokin.
Kilbourn, William Robert,	M.E.,	Williamsport.
Kivert, Joseph Albert,	Ch.E.,	Northampton.
Kleine, Herbert Julius,	M.E.,	Philadelphia.
Knoderer, Claude Luther,	E.E.,	Steelton.
Korbel, Alexander,	M.E.,	Bethlehem.
Kozlakiewicz, Walter,	C.E.,	Wilkes-Barre.
Lamb, Earl Washington,	E.M.,	Natalie.
Larkin, Paul Revere,	C.E.,	Wollaston, Mass.
Larkin, Sylvester Makens,	C.E.,	Norristown.
Lerch, Robert Lee,	Ch.E.,	Takoma Park, D. C.
Little, Arthur Rhea,	Met.,	Petersburg.
Lutz, Warren Hornberger,	E.E.,	Denver.
McGovern, Edward William, jr.,	Ch.E.,	Hammonton, N. J.
McKenzie, Carl Harry,	Bus.,	Dallas, Tex.
Major, Harold Wagner,	Ch.E.,	Lehman.
Marshall, James Floyd,	M.E.,	Wilkes-Barre.
Marshall, John Noble,	C.E.,	Pittsburgh.
Mattson, William Raymond,	C.E.,	Rockledge.
de Menezes, Godofredo Moraes,	C.E.,	Aracaju, Sergipe, Brazil.
Michell, Albert McIlvaine,	E.M.,	Marion, Ky.
Miller, Paul Edward,	N.E.,	Bellwood.
Miller, Roy Francis,	E.M.,	Altoona.
Miszkiel, Victor Stanley, jr.,	E.E.,	Ashley.
Moorehouse, John Walter,	E.E.,	Monaca.
Morgan, Harold William,	C.E.,	Altoona.
Morris, Richard Henry, 3rd,	Ch.E.,	Philadelphia.
Mumma, Paul Fisher,	Met.,	Waynesboro.

Nass, George, 3rd,	M.E.,	Overbrook.
Pfeiffer, John,	Ch.E.,	Washington, D. C.
Platt, Harold Wentzell,	C.E.,	Bridgeton, N. J.
Potts, Ralph Harrison,	Ch.E.,	Reading.
Prigohzy, Adolph Theodore,	E.M.,	Brooklyn, N. Y.
Reichard, Paul Clader,	M.E.,	Allentown.
Reynolds, Edwin Louis,	C.E.,	Bethesda, Md.
Rhoad, Robert Rodney,	N.E.,	Philadelphia.
Ricketts, Leslie Cutler,	M.E.,	Barre, Mass.
Riebe, Herman William,	C.E.,	Lansford.
Rodgers, Samuel Procter,	M.E.,	Baltimore, Md.
Salmon, Clarence Prior,	Met.,	Rochester, N. Y.
Saltzman, Auguste Louis,	M.E.,	East Orange, N. J.
Sanborn, Norman Prime,	C.E.,	Cleveland, O.
Satterthwait, Charles Shoemaker,	C.E.,	Burmont.
Schaefer, Bernard Edward,	E.M.,	Allentown.
Schier, Wallace,	Bus.,	Kew Gardens, N. Y.
Schlesman, Carlton Hecker,	Ch.E.,	Allentown.
Schneider, Carl Louis,	M.E.,	Elizabeth, N. J.
Schwartz, Earl Dum,	C.E.,	Harrisburg.
Shearer, Walter Louis,	Ch.E.,	Washington, D. C.
Shipley, Samuel Hunt,	Ch.E.,	York.
Silsby, Charles Forbes,	Ch.E.,	Washington, D. C.
Smith, Hubert Bell,	C.E.,	Philadelphia.
Spatz, Warren Cyrus,	E.E.,	Reading.
Steiner, Carl Herman,	E.E.,	Reading.
Stimson, Earl, jr.,	M.E.,	Baltimore, Md.
Strauch, Charles Carter,	M.E.,	Pottsville.
Stutz, George Frederick Adelbert, jr.,	Ch.E.,	Washington, D. C.
Summers, Milo Whitney,	E.M.,	Washington, D. C.
Swinton, George Robert,	C.E.,	Atlantic City, N. J.
Switz, Theodore MacLean,	Ch.E.,	East Orange, N. J.
Tavenner, William Henry,	E.M.,	Washington, D. C.
Terry, Peyton Leftwich,	M.E.,	Roanoke, Va.
Thaeler, Abraham Schropp,	N.E.,	Nazareth.
Tumbler, Joseph,	Ch.E.,	Baltimore, Md.
Van Nort, Lawrence Northup,	M.E.,	Scranton.
Vogt, Harold James,	Ch.E.,	Brooklyn, N. Y.
Wallace, Harold Dolson,	C.E.,	East Orange, N. J.

Walters, George Wilmer,	E.M.,	Cazenovia, N. Y.
Waltz, William Hurr,	C.E.,	Williamsport.
Warren, Austin Bartlett,	N.E.,	Westfield, Mass.
Weber, Herman Ludwig,	B.A.,	Allentown.
Whims, Edmund Joseph,	C.E.,	Saint Clair.
Whitney, Leslie Clifton,	Met.,	Marlboro, Mass.
Whytock, Paul Knauss,	Bus.,	Bethlehem.
Williamson, Stuart Worley,	E.M.,	Womelsdorf.
Wilson, John Edgar Miller,	E.M.,	Bethlehem.
Wilson, Ralph Lawrence,	Met.,	Canton, O.
Wingate, Abram Reber, jr.,	C.E.,	Washington, D. C.
Woelfel, Harold Martin,	N.E.,	Freeland.
Wolfe, Charles Russell,	Ch.E.,	Asbury Park, N. J.
Wood, Robert Thomas,	Met.,	Palmerton.
Zinszer, Harvey Alfred,	B.A.,	Bethlehem.

JUNIOR CLASS

Class of 1923

	Course	Residence
Abel, Stanford Edward,	C.E.,	Washington, D. C.
Amig, William Van Wert,	M.E.,	Baltimore, Md.
Ancona, Frederick Bechtel,	E.E.,	Reading.
Angulo, Antonio,	M.E.,	Barranquilla, Colombia, S. A.
Appel, Carl Wilson,	E.E.,	Allentown.
Asbury, Thomas Henry,	Bus.,	Philadelphia.
Bahnsen, Conrad Mortimer,	B.A.,	Nazareth.
Balderson, Robert Power,	Bus.,	Pittsburgh.
Barber, Frederick Edwin,	E.E.,	Allentown.
Barrall, John Kenneth,	B.A.,	Allentown.
Barrell, Robert Webb, jr.,	E.E.,	St. Louis, Mo.
Beale, Edward Belknap,	Ch.E.,	Washington, D. C.
Beck, Rodney Maurer,	Ch.E.,	Philadelphia.
Beitzel, Horace Clifton, jr.,	M.E.,	Philadelphia.
Bessemer, Stephen Joseph,	Bus.,	Bethlehem.
Bieg, Henry Conrad,	E.M.,	Philadelphia.
Bishop, Charles Fletcher,	E.E.,	Williamsport.
Blankenbuehler, John Henry,	E.E.,	Elizabeth.
Bloch, Elmer Morton,	B.A.,	Newport, R. I.
Bockel, George Robert,	C.E.,	Johnstown.
Bodey, Carl Franklin,	E.E.,	Reading.

Borden, George Centennial, jr.,	Ch.E.,	Asbury Park, N. J.
Boyd, James Andrew,	Bus.,	Montvale, N. J.
Boyden, Wilson Gordon,	E.E.,	Greenwich, Conn.
Boyer, Willard Albert Solomon,	B.A.,	Lehighton.
Bradley, Clifton Newton,	Bus.,	Brooklyn, N. Y.
Bray, Lennox Jerome,	M.E.,	Westerly, R. I.
Brotzman, Reginald Philip,	E.E.,	Bethlehem.
Buckley, John Brooke,	N.E.,	Port Edwards, Wis.
Burgess, Charles Owen,	Met.,	Niagara Falls, N. Y.
Bush, Charles Roland, jr.,	C.E.,	Washington, D. C.
Callahan, George White Gregory, jr.,	C.E.,	Newport, R. I.
Camm, John Palmer,	E.M.,	Atlantic City, N. J.
Carey, James White, jr.,	M.E.,	Wenonah, N. J.
Carlisle, William Albert,	Bus.,	Luthersburg.
Christman, Calvin Claude,	B.A.,	Lehighton.
Clarke, David Mesesr,	C.E.,	Bee Ridge, Fla.
Compher, Wilfred Clinton,	Bus.,	Barnesville, Md.
Conlin, John Francis, jr.,	Bus.,	Philadelphia.
Cosh, William Harold,	C.E.,	Vineland, N. J.
Cox, Newton Perkins,	E.E.,	Philadelphia.
Coxe, Edward Haviland, jr.,	E.E.,	Pittsburgh.
Craig, Thomas Benneville,	M.E.,	Slatington.
Creighton, Arthur Morgan,	Met.,	Bayonne, N. J.
Cusick, Arthur Cabot,	M.E.,	Roxbury, Mass.
Darsie, James Hazen,	E.M.,	West Homestead.
Davis, Edward Chester,	M.E.,	Taylor.
Davis, Norris Dunglison,	Bus.,	Conshohocken.
Decker, Everett Judd,	E.M.,	Mountain Lakes, N. J.
Dehnick, Joseph Albert,	C.E.,	Atlantic City, N. J.
DeMoyer, Frank Hart,	C.E.,	Camden, N. J.
DePuy, Stuart Walton,	Ch.E.,	Hammonton, N. J.
Derrick, Charles Luther,	E.E.,	Washington, D. C.
Desh, George Jacob,	B.A.,	Bethlehem.
Dithridge, Edward Hay,	Ch.E.,	Morrisville.
DuBois, Howard Higbee,	E.M.,	Philadelphia.
Dynan, Harold Baker,	Met.,	Bethlehem.
Erb, John Edgar,	Met.,	Middletown.
Ertner, Harold Sigmond,	C.E.,	Camden, N. J.
Eshbach, Truman Walter,	B.A.,	Bethlehem.
Fancher, Charles Melvin,	N.E.,	Elizabeth, N. J.

Farace, Samuel,	E.E.,	Baltimore, Md.
Farkas, Harold,	Ch.E.,	Newark, N. J.
Fehr, Howard Franklin,	B.A.,	Bethlehem.
Felmley, Charles Lauren,	E.E.,	Oldwick, N. J.
Ferguson, Frank Elliott, jr.,	E.E.,	Washington, D. C.
Ferris, Edwin Alden,	M.E.,	Ridgefield Park, N. J.
Ferry, John Francis,	E.E.,	Allentown.
Foot, Cyril Hughes,	M.E.,	Westfield, N. J.
Forney, Charles David,	E.E.,	Hanover.
Forstall, Charles Fletcher,	C.E.,	Rosemont.
Freeman, Carlos Alphonso,	E.M.,	Caracas, Venezuela.
Fuld, Melvin,	E.E.,	Baltimore, Md.
Ganey, Thomas Vincent,	Bus.,	Bethlehem.
Garber, Meyer Isadore,	Ch.E.,	Norristown.
Gardy, Julian Washington,	Bus.,	Doylestown.
Garman, Edwin Lester Meckley,	Bus.,	Harrisburg.
Gentzlinger, Henry Werner,	C.E.,	New York, N. Y.
Getz, David,	B.A.,	Allentown.
Gihon, Harry David,	M.E.,	Trenton, N. J.
Graff, Richard Morris,	E.M.,	Worthington.
Green, Kenneth William,	E.E.,	Weissport.
Groff, Joseph Coblentz,	M.E.,	New York, N. Y.
Guthrie, Nelson Rawlins, jr.,	C.E.,	Baltimore, Md.
Hacker, Robert Trost,	E.M.,	Toledo, O.
Hagenbuch, Edward Allen, jr.,	E.E.,	Allentown.
Hales, Ralph Alonzo,	Ch.E.,	Washington, D. C.
Hardcastle, Edward,	E.E.,	Easton, Md.
Harkins, Linus Kenneth,	B.A.,	Homestead.
Hartung, Philip Halstead,	M.E.,	Yonkers, N. Y.
Hauck, Adam Edward,	E.M.,	Buffalo, N. Y.
Heikes, George Conrad,	Met.,	Salt Lake City, Utah.
Hicks, Albert Willet, jr.,	E.M.,	Allentown.
Hitchner, Adam Hannan,	E.M.,	Woodbury, N. J.
Hogg, Wallace Bruce,	Bus.,	Pittsburgh.
Hoke, William Mason,	E.E.,	Lebanon.
Hopkins, George Whitefield,	M.E.,	Cleveland, O.
Hornbostel, Lloyd,	M.E.,	New York, N. Y.
Hull, John Sommers,	M.E.,	Cleveland, O.
Huston, James Stewart,	Met.,	Coatesville.
Israel, Charles Henry, jr.,	Ch.E.,	Philadelphia.

Jacobson, Louis John,	C.E.,	Washington, D. C.
Johnson, Alfred William,	E.E.,	West Hartford, Conn.
Johnston, Byron Albert Chapman,	E.M.,	Tompkinsville, N. Y.
Kaman, Samuel,	B.A.,	New York, N. Y.
Kennedy, Jamieson Douglas,	B.A.,	North Adams, Mass.
Killmer, Jack Kaufman,	Met.,	Reading.
Klaas, Walter Ernest,	Bus.,	Montclair, N. J.
Knodel, Charles Gotthilf,	M.E.,	Allentown.
Knouse, Walter Earl,	E.E.,	Washington, D. C.
Koch, George Schneider,	E.E.,	Washington, D. C.
Kocher, Walter Merritt,	C.E.,	Allentown.
Kofke, Charles Lewis,	Met.,	Philadelphia.
Kramer, Allan Reuel,	E.E.,	Coplay.
Kramer, Harold Kusel,	M.E.,	Brooklyn, N. Y.
Kravitz, Raphael,	E.M.,	Atlantic City, N. J.
Kreisel, John Werner,	B.A.,	Pen Argyl.
Kressler, Charles Horner,	E.E.,	Finesville, N. J.
Kurtz, Irvin Faust,	C.E.,	Pottstown.
Kutzleb, Richard, jr.,	M.E.,	Baltimore, Md.
Lambert, Tilghman Albert,	B.A.,	Bethlehem.
Laufer, Harry Edgar,	Bus.,	Bethlehem.
Laughton, William Miller,	Met.,	Washington, D. C.
Lazarus, Franklin Thomas Wright,	Bus.,	Bethlehem.
Lebovitz, Samuel Llewellyn,	E.M.,	Baltimore, Md.
Lees, John Luther,	C.E.,	Hellertown.
Leister, Frank Henry, jr.,	C.E.,	North Wales.
Lewis, Frederick William,	B.A.,	Pottsville.
Light, Joel Longenecker,	E.M.,	Allentown.
Lodge, Friend Horace,	C.E.,	Philadelphia.
Lyons, Grant Maxwell,	B.A.,	Warren.
McCarthy, Raymond Timothy,	Bus.,	Easton.
McConnell, George D.,	Bus.,	Butler.
McFadden, Michael Charles Joseph,	Met.,	Bethlehem.
McNulty, Carrell Stewart,	C.E.,	Washington, D. C.
McPherson, John Douglas, 3d,	E.E.,	Fair Oaks, Cal.
Magruder, Elbert Tyler,	M.E.,	Winchester, Va.
Mecaslin, Harry Benton, jr.,	E.E.,	Baltimore, Md.

Mercur, Robert Sayre,	E.M.,	Harrisburg.
Meyer, Theodore Henry H.,	B.A.,	Newark, N. J.
Miller, Charles Heck,	Ch.E.,	Ancora, N. J.
Minnich, Charles Raymond,	C.E.,	Robesonia.
Minnich, Joseph Pilkay,	E.E.,	Harrisburg.
Mitman, Frederick Snyder,	E.M.,	Bethlehem.
Mitman, Harry Ammon,	Ch.E.,	Northampton.
Molloy, James Xavier,	N.E.,	Bridgeport, Conn.
Moyer, Joseph Fretz,	C.E.,	Quakertown.
Muirhead, Andrew Wilson,	M.E.,	Bridgeport, Conn.
Mumford, Warren Huidekoper,	Bus.,	Cambridge, Mass.
Muschlitz, Wilbert David,	B.A.,	Bethlehem.
Muzdakis, John Robert,	E.E.,	Baltimore, Md.
Nadig, Stanton Elwell,	N.E.,	Allentown.
Nevins, Samuel Craig,	Ch.E.,	Tamaqua.
Newlin, James Memmert,	E.M.,	Sparrows Point, Md.
Nichols, Robert Warren,	E.E.,	Asbury Park, N. J.
O'Keefe, Francis Callistus,	Bus.,	Rockville, Conn.
Olcott, John Hedrick,	C.E.,	Glencarlyn, Va.
Old, Marcus Calvin,	B.A.,	Allentown.
Opdycke, John Hinkle,	Bus.,	Philadelphia.
Palmer, Henry Parsons,	C.E.,	Langhorne.
Passmore, Henry Etter, jr.,	M.E.,	Columbus, O.
Petersen, Theodore Otto,	Ch.E.,	Philadelphia.
Pfahler, Robert Gair,	E.M.,	Wilkes-Barre.
Philippides, John Argyrios,	B.A.,	Athens, Greece.
Picht, George Christopher, jr.,	E.E.,	Bethlehem.
Piersol, John Marshall,	E.M.,	Philadelphia.
Pill, Frank, jr.,	B.A.,	Califon, N. J.
Platt, Robert,	Ch.E.,	Westfield, N. J.
Plumb, Rollo Green,	B.A.,	Bethlehem.
Quick, Donald Mott,	M.E.,	Yonkers, N. Y.
Quier, Kenneth Elwell,	M.E.,	Bethlehem.
Quigley, Raymond Joseph,	Ch.E.,	Jeddo.
Randall, Harradon Reets,	E.M.,	Shamokin.
Read, John Mason,	C.E.,	Washington, D. C.
Redington, Joseph Patrick,	Bus.,	Wilkes-Barre.
Regad, Eugene Desire,	E.E.,	Irvington, N. J.
Reif, Fulmer Jacob, jr.,	Ch.E.,	Harrisburg.
Reiter, Irvin Sterner,	Met.,	Bethlehem.

Rhoades, Ronald Sage,	E.M.,	Nutley, N. J.
Rhoads, Byron Elmer, jr.,	C.E.,	Big Stone Gap, Va.
Richards, Elmer Lincoln, jr.,	C.E.,	Somerville, N. J.
Rieman, Edwin Frederick,	E.E.,	Tamaqua.
Riley, John Stephen,	E.E.,	Willimantic, Conn.
Robinson, John Bunyan,	E.M.,	Chester.
Roller, Oscar Frederic, jr.,	Ch.E.,	Philadelphia.
Rote, Harry Frederick,	Bus.,	Harrisburg.
Rubba, Russell,	Ch.E.,	Hammonton, N. J.
Ruger, Raymond Philip,	C.E.,	Philadelphia.
Sansom, Edward Marsh,	Ch.E.,	Cranford, N. J.
Saunders, Oliver Hubbard, jr.,	M.E.,	Brooklyn, N. Y.
Schaefer, Everett Gordon,	Ch.E.,	New York, N. Y.
Schifreen, Clement Solomon,	E.E.,	Catasauqua.
Schragger, Charles Nelson,	Ch.E.,	Trenton, N. J.
Schrauff, Henry John,	E.M.,	Jersey City, N. J.
Schwab, Thomas Wesley, jr.,	B.A.,	Bath.
Schwarzbach, Alvin August Claus,	E.M.,	Newark, N. J.
Settle, Richard Torpin,	Ch.E.,	Drexel Hill.
Sharp, Charles Compton,	C.E.,	Bridgeton, N. J.
Sheetz, Olin Curtis,	Met.,	Philadelphia.
Shoemaker, H. E. Walter,	C.E.,	Freeland.
Shoemaker, Lewis Foulke, jr.,	C.E.,	Devon.
Sieman, Arthur Louis,	C.E.,	Brooklyn, N. Y.
Smith, Leslie Ewart,	E.M.,	East Mauch Chunk.
Smith, Thomas Cameron,	M.E.,	Allentown.
Snyder, Edwin Henry, jr.,	E.E.,	Washington, D. C.
Stafford, Samuel Alfred,	Met.,	Coraopolis.
Stanier, John Stewart,	Bus.,	Tarentum.
Stanley, Leslie Wright,	B.A.,	Williamsport.
Stanton, Thomas William,	Bus.,	East Orange, N. J.
Steiner, William Joseph Henry,	Bus.,	New York, N. Y.
Stewart, Joseph Baird,	E.M.,	Philadelphia.
Stoll, John Howard,	Met.,	Bethlehem.
Taylor, John Wright, jr.,	M.E.,	Century, Fla.
Thomas, John Archibald,	E.M.,	Scranton.
Thompson, William Gardiner,	E.M.,	Richmond Hill, N. Y.
Todd, James Arnold,	Ch.E.,	Doylestown.
Trumbore, Frederick William,	M.E.,	Bethlehem.

Underwood, Herbert Francis,	M.E.,	Brooklyn, N. Y.
Van Billiard, Lewis Howard,	E.E.,	Bethlehem.
Van Keuren, Edwin,	B.A.,	Bethlehem.
Van Ness, John Harold,	C.E.,	Paterson, N. J.
Voss, Charles Abbott,	Bus.,	Brooklyn, N. Y.
Wallace, Edward Allen, jr.,	Bus.,	Grand Rapids, Mich.
Walters, Frank Clayton,	N.E.,	Bethehem.
Walton, Joseph Edward,	C.E.,	Bethlehem.
Webb, Robert Stanford,	M.E.,	Asheville, N. C.
Wentling, Lee Grant,	M.E.,	Conshohocken.
Wentz, James,	Bus.,	New York, N. Y.
Werner, David Thomas,	E.E.,	Lebanon.
Wight, Donald Miller,	M.E.,	Washington, D. C.
Wilkins, Paul Edwin,	C.E.,	Baltimore, Md.
Wingate, Bruce Kuglow,	C.E.,	Reading.
Wire, Charles Raymond,	C.E.,	Washington, D. C.
Wolensky, Barney Louis,	Bus.,	Palmerton.
Wright, Frederic Flavel,	Bus.,	Harrisburg.
Wuethrich, Adolph Gustave,	Met.,	Perth Amboy, N. J.
Zantzinger, Richard Chew,	Bus.,	Hyattsville, Md.

SOPHOMORE CLASS

Class of 1924

	COURSE	RESIDENCE
Abel, George Justin,	M.E.,	Elizabeth, N. J.
Acker, Swope,	E.E.,	Baltimore, Md.
Adams, Edgar Thomas, jr.,	E.M.,	Crafton.
Adams, Robert Wilson,	E.M.,	Crafton.
Alford, Charles Mahin,	E.E.,	East Orange, N. J.
Allan, Robert Houston,	Bus.,	Jermyn.
Alwine, Charles Emory,	E.E.,	New Oxford.
Angulo, Isaac Carlos,	Ch.E.,	Barranquilla, Colombia, S. A.
Arter, Adelbert Allison,	E.M.,	Youngstown, O.
Atwood, Henry Martyn,	B.A.,	Buffalo, N. Y.
Ayers, William DeWitt,	C.E.,	Branchville, N. J.
Baker, Ernest Wellington,	E.E.,	Harrisburg.
Beckman, George William,	M.E.,	Hellertown.
Bell, George Howard,	Bus.,	Canton, O.
Benner, Ralph Chalfont,	M.E.,	Atglen.

Bennett, Edmund Van Gilder,	Met.,	Lansdale.
Bergen, Howard Beekman,	E.E.,	Newtown.
Bishop, Morris Earl,	B.A.,	Bethlehem.
Blake, Alfred Green,	M.E.,	Pittsburgh.
Blessing, Raymond Joseph,	Ch.E.,	Reading.
Boggs, George Warren,	Bus.,	Melrose Park.
Bond, Louis Boutell,	M.E.,	Philadelphia.
Bond, Luther Gerrer, jr.,	M.E.,	York.
Bonney, Henry Ernest,	B.A.,	Pen Argyl.
Bortz, Carl Martin,	Bus.,	Pittsburgh.
Boyle, Joseph, jr.,	Bus.,	Paterson, N. J.
Bridegam, Warren James,	E.E.,	Reading.
Brookfield, Frederic W.,	Met.,	Syracuse, N. Y.
Buck, Richard Joseph,	B.A.,	Bethlehem.
Buechley, Frank Seltzer,	Bus.,	Pottsville.
Bugbee, Jesse Albert,	C.E.,	Trenton, N. J.
Bumbaugh, Frank Taylor,	Met.,	Monessen.
Burdick, William Foster,	B.A.,	Uniondale.
Burt, Paul Shafter,	Bus.,	Washington, D. C.
Campbell, Paul Frederick,	C.E.,	Swedesboro, N. J.
Campbell, William Brunner,	Bus.,	Lebanon.
Canavan, William Paul,	B.A.,	Chester.
Carol, José Maria,	C.E.,	Cardenas, Cuba.
Carpenter, Henry Bartleson, jr.,	M.E.,	Montclair, N. J.
Carter, Norman Campbell,	Ch.E.,	Phoenixville.
Chang, Kuang-Ming,	Met.,	Shanghai, China.
Clark, John Edmund Duncan,	M.E.,	Wilmington, N. C.
Cluthe, Carl, 3d,	Bus.,	Glen Ridge, N. J.
Coleman, Douglas Fleming,	B.A.,	Jersey City, N. J.
Coleman, Spencer Albert,	Met.,	Cleveland, O.
Conley, Thomas George, jr.,	E.M.,	Pittsburgh.
Cook, Roland Fuller,	M.E.,	Bloomfield, N. J.
Cornelius, Charles Taylor,	M.E.,	Pittsburgh.
Cornelius, George Emil Wagner,	Bus.,	McKeesport.
Cottman, Llewellyn Powell,	Ch.E.,	Baltimore, Md.
Cousens, Harold Franklin,	Bus.,	Arlington, Mass.
Cupp, Laylon Lavern,	M.E.,	Newberry.
Danko, John Vincent,	E.M.,	Port Chester, N. Y.
Davidson, Stuart Ross,	N.E.,	Elizabeth, N. J.
Davis, William Shaff, jr.,	E.M.,	Lebanon.

Degnan, James Michael, jr.,	E.E.,	Bethlehem.
DiBiase, James,	Bus.,	Newark, N. J.
Dick, Donald Benner,	Bus.,	Hazleton.
Dickinson, Ansel Reed,	E.E.,	East Whately, Mass
Diener, Walter Miller,	M.E.,	Hamburg.
Dietrick, Robert Charles,	B.A.,	High Bridge, N. J.
Dietz, Joseph Budding,	Ch.E.,	Lancaster.
DiGuilian, Attilio Peter,	C.E.,	Washington, D. C.
Dixon, Henry Marshall, jr.,	E.E.,	Washington, D. C.
Donaldson, Kenneth,	C.E.,	Washington, D. C.
Douglass, Norman Engleman,	Ch.E.,	Ambridge.
Drake, William Robert,	C.E.,	Reading.
Edson, Warren Newton,	M.E.,	Scranton.
Emanuel, Robert Samuel,	M.E.,	Nesquehoning.
Ennis, Robert William,	C.E.,	Mount Penn.
Eskew, Arthur Howell,	E.E.,	Asbury Park, N. J.
Feick, Rufus Daniel,	Ch.E.,	Kutztown.
Fleck, Paul Butler,	E.M.,	Pittsburgh.
Focht, Louis Herman Doster,	E.M.,	Trenton, N. J.
Foster, Arthur Lee,	E.E.,	Allentown.
Fox, Edward George,	E.M.,	Pottsville.
Frey, Frank Gustave, jr.,	M.E.,	Baltimore, Md.
Fritzsche, Otto Herbert Adolph,	C.E.,	Irvington, N. J.
Fugate, Howard,	B.A.,	Easton.
Gallagher, Charles Barto,	B.A.,	Asbury Park, N. J.
Galloway, Beverly Stewart,	B.A.,	Takoma Park, D. C.
Garbarino, Stephen Lawrence,	Bus.,	Shanandoah.
Garra, Edward Joseph,	E.E.,	White Haven.
Gee, Elisha, jr.,	Ch.E.,	Denver, Col.
Geho, Charles Henry,	Ch.E.,	Allentown.
Genshart, Fred William Kriebel,	B.A.,	East Mauch Chunk.
Gerhart, Paul Leroy,	E.E.,	Reading.
Glen, Maxwell,	Bus.,	Newbury, Mass.
Good, Robert Dewalt,	E.M.,	Allentown.
Gorham, Edward Werrey,	Ch.E.,	Brooklyn, N. Y.
Gorman, Joseph Francis, jr.,	M.E.,	Allentown.
Gould, Edson Beers, jr.,	B.A.,	Asbury Park, N. J.
Grace, Carroll Brewster, jr.,	M.E.,	Philadelphia.
Graessle, Eugene Frederick,	Bus.,	Brooklyn, N. Y.
Grambs, George Lorenzo,	B.A.,	Scranton.

Gray, George, jr.,	M.E.,	Philadelphia.
Greacen, Walter, 3rd,	Bus.,	East Orange, N. J.
Greer, Harry Ross,	B.A.,	Atlanta, Ga.
Grim, James Stewart, jr.,	E.E.,	Kutztown.
Hampton, George,	Ch.E.,	Bridgeton, N. J.
Harman, Edward Hosfield,	E.E.,	New York, N. Y.
Harper, Robert Malcolm,	Bus.,	Butler.
Hartman, Edward Paul,	Met.,	Bethlehem.
Hauser, Roderick Ritter,	Bus.,	Allentown.
Hauser, Stanley LeRoy,	Met.,	Kutztown.
Hawkins, Richard Arthur,	E.M.,	Forty Fort.
Heckert, Robert Augustus,	B.A.,	Brackenridge.
Heimbrook, Charles Albert,	Bus.,	Bethlehem.
Hendrickson, Francis Lynn,	E.M.,	Woodbury, N. J.
Henry, Eugene Harvey, jr.,	C.E.,	Lancaster.
Henschen, Leroy,	E.E.,	Baltimore, Md.
Heske, Walter Gottlieb,	Met.,	Bethlehem.
Hewson, Edward Haskell,	N.E.,	Madison, N. J.
High, Byron Gilbert,	B.A.,	Pottstown.
Hiller, Charles Francis,	B.A.,	Buchanan, Mich.
Hitchcock, Sidney Clarence,	B.A.,	Utica, N. Y.
Hoagland, Dan Parmlee, jr.,	B.A.,	Bayonne, N. J.
Hoffman, William Jacob,	B.A.,	Raubsville.
Hohl, Joseph Louis,	E.M.,	Catasauqua.
Homeyer, William Henry,	B.A.,	Jersey City, N. J.
Hopkins, John William,	C.E.,	Ambler.
Horowitz, Abel Charles,	Bus.,	Jersey City, N. J.
Hottinger, Alwin Julius,	Met.,	Kenvil, N. J.
Howell, Richard Paulmier,	E.M.,	Devon.
Huggins, William Grenell,	Bus.,	Adams, N. Y.
Hunter, Francis Alexander,	M.E.,	Hoboken, N. J.
Hurtado, Juan,	C.E.,	Mexico City, Mexico.
Jamieson, John Jay Ivory,	Met.,	Frackville.
Jamison, Earl Helmes,	E.E.,	Hazleton.
Jenkins, George French,	E.M.,	Binghamton, N. Y.
Johnson, Sidney Edward,	Bus.,	Dayton, O.
Jones, Gordon Tyron,	B.A.,	Edwardsville.
Kasper, Ralph Joseph,	N.E.,	Ridgefield, Conn.
Keefer, Samuel Mumber,	E.E.,	Danville.
Keller, Edwin Walker,	Bus.,	Allentown.

Kemmerer, Walter William,	B.A.,	Wind Gap.
Kichline, William Levi,	B.A.,	Bethlehem.
Kiefer, Herman Eugene, jr.,	C.E.,	Quincy, Ill.
Kitchen, John C., jr.,	Ch.E.,	Columbia, N. J.
Klein, Walter Conrad,	B.A.,	Pottsville.
Kniley, Clifford Leroy,	Bus.,	Tower City.
Koller, Charles Oliver,	E.M.,	New Freedom.
Kratz, Wilbur,	M.E.,	Baltimore, Md.
Langfitt, James Porter,	B.A.,	Parkersville, W. Va.
Lau, Zau Ji,	Ch.E.,	Shanghai, China.
Laux, George August,	M.E.,	Baltimore, Md.
Laux, Louis Albert,	M.E.,	Baltimore, Md.
Ledoux, Leonard Knox,	M.E.,	Swarthmore.
Levy, Bertram Rich,	E.E.,	Brooklyn, N. Y.
Lewis, John Herbert,	C.E.,	North Wales.
Light, Berlin Carl,	Ch.E.,	Reading.
Light, Simon Peter, jr.,	E.M.,	Lebanon.
Linaberry, Stanley Simrell,	C.E.,	Columbia, N. J.
Lingle, Charles Fitting,	Bus.,	Harrisburg.
Litke, Harry Theodore,	C.E.,	Millville, N. J.
Long, Willoughby James,	Met.,	Bethlehem.
Lord, Edward Thomas Warren,	Ch.E.,	Philadelphia.
Lozano, Hector,	Ch.E.,	Monterey, Mexico.
Luce, Donald Cameron,	E.E.,	Scranton.
Lundberg, George Otto,	M.E.,	Lansing, Mich.
MacKenzie, Adrian Morell,	Bus.,	Englewood, N. J.
McBride, Hardack Theodore,	M.E.,	Spencer, N. C.
McBride, John Leo,	B.A.,	Phillipsburg, N. J.
McBride, Joseph Aloysius,	M.E.,	Philadelphia.
McElvain, Clarence Newton,	Bus.,	Red Oak, Ia.
McIntire, Robert Lester,	Bus.,	Butler.
Mackenzie, Sidney Thompson,	N.E.,	Philadelphia.
Maguire, Joseph Anthony,	B.A.,	Vineland, N. J.
Major, William Samuel,	Ch.E.,	Roebling, N. J.
Mandell, Leon Nathaniel,	Ch.E.,	Philadelphia.
Manley, Herbert Waldo,	B.A.,	Canton.
Martin, Frederic Thurman,	Ch.E.,	Harrisburg.
Master, Warren S.,	E.E.,	Reading.
Maxwell, Thomas,	E.E.,	Baltimore, Md.
Mechling, John Younkins,	M.E.,	Casper, Wyo.

Mellinger, Albert Charles, jr.,	B.A.,	Lancaster.
Metzner, Russell Henry,	M.E.,	Wheeling, W. Va.
Meyer, William Charles,	E.E.,	Bethlehem.
Miller, Philip Robert,	B.A.,	Bethlehem.
Miller, William Hurxthal,	E.E.,	Glendale, O.
Milligan, John Ralph,	Bus.,	East Liverpool, O.
Minster, Pemberton Foster,	Bus.,	Bristol.
Mitchell, Charles Bayard, 2nd,	E.M.,	Woodbury, N. J.
Moore, Myron Turner,	Bus.,	Youngstown, O.
Morgan, Harry Melville,	Bus.,	Bethlehem.
Morgan, Josiah Dodson,	E.E.,	Allentown.
Myers, John Alfred,	M.E.,	York.
Northup, Maynard Sanbon,	Met.,	Allentown.
O'Brien, William Henry, jr.,	Bus.,	Lynbrook, N. Y.
Palmer, William Francis,	Ch.E.,	Reading.
Parker, Joseph Henry,	Bus.,	Milwaukee, Wis.
Parsons, Donald Adelbert,	M.E.,	New Rochelle.
Patterson, Daniel Walter,	C.E.,	Bethlehem.
Patterson, John Alexander, jr.,	Ch.E.,	Philadelphia.
Patty, Claibourne Watkins,	E.M.,	Little Rock, Ark.
Paxton, George Benjamin,	E.E.,	Harrisburg.
Pearson, Frederick Joseph,	B.A.,	Wilkes-Barre.
Penwell, Max Kenneth,	E.M.,	Pana, Ill.
Quinlan, Eldridge Edward,	Bus.,	Newark, N. J.
Rakestraw, Theodore Horace,	E.M.,	Porto Delgrade, Azores.
Ratajczak, Frank Xavier,	B.A.,	Reading.
Reams, Louis Milton,	M.E.,	Richmond, Va.
Redline, Paul Wilson,	E.M.,	Bethlehem.
Reese, Benjamin Harvey,	Bus.,	Kingston.
Reilly, John Kennedy,	Bus.,	Spangler.
Reyer, William Aaron,	Ch.E.,	Northampton.
Rice, Charles Lewis,	C.E.,	Hazleton.
Rice, Janvier Mayhew,	E.E.,	Bridgeton, N. J.
Richards, Louis Moore,	M.E.,	Somerville, N. J.
Richardson, Edward Hardy,	C.E.,	Malvern.
Ritter, Ralph Shelly,	E.E.,	Quakertown.
Roberts, Arthur Parsons,	Bus.,	Englewood, N. J.
Roberts, Evan Emlyn,	M.E.,	Dunmore.
Robinson, Edmund Lewis,	E.E.,	Bethlehem.

Robinson, Harry George,	M.E.,	Trenton, N. J.
Robinson, James Wood,	E.M.,	Conshocken.
Robinson, John Mealy,	M.E.,	Pittsburgh.
Rogers, Henry Gordon,	Ch.E.,	Newark, N. J.
Rogers, John Frederick,	Bus.,	Buffalo, N. Y.
Rohrer, Henry Augustus,	M.E.,	Lancaster.
Romoser, William Kilian,	M.E.,	Baltimore, Md.
Ross, Jack Elton,	C.E.,	Newark, N. J.
Rouch, Ernest Allen,	M.E.,	York.
Ruttenberg, Benjamin Franklin,	Bus.,	Reading.
Ryan, Michael Joseph, jr.,	B.A.,	Bethlehem.
Sanford, James Leo,	B.A.,	Long Beach, N. Y.
Sattenstein, Sidney Lincoln,	E.E.,	Reading.
Sayre, Austin Bartholomew,	B.A.,	Glen Ridge, N. J.
Schaffer, George Washington,	Met.,	Allentown.
Scheetz, Edwin Freed,	E.M.,	Wyncote.
Schleicher, Wallace Mengel,	N.E.,	Maplewood, N. J.
Schoenfeld, Lester Wolfson,	E.E.,	Philadelphia.
Schreier, Harry,	Bus.,	New York, N. Y.
Schultz, Albert Novinger,	E.E.,	Williamsport.
Schwartz, Paul Englebert,	Bus.,	Harrisburg.
Scofield, Edmond Preston,	Ch.E.,	Bayonne, N. J.
Seideman, Sidney,	Bus.,	Philadelphia.
Shelly, Freeman Moyer,	Bus.,	Allentown.
Shigo, John Joseph, jr.,	B.A.,	Freeland.
Simmons, John Stegner,	E.M.,	Scranton.
Skeels, Walter Simeon,	E.M.,	Newark, N. J.
Skolnick, Leonard Judah,	Chem.,	Newark, N. J.
Snyder, Amandus Deischer, jr.,	Ch.E.,	Pennsburg.
Snyder, Frederick Deppen,	Ch.E.,	Harrisburg.
Sprague, John Frederick,	E.M.,	Raleigh, N. C.
Springsteen, Arthur Wellington,	B.A.,	Detroit, Mich.
Springsteen, William Watson,	Bus.,	Detroit, Mich.
Stauffer, Edwin Lewis,	Ch.E.,	Northampton.
Stern, Paul Hertzler,	B.A.,	Elizabethtown.
Stille, Francis Carroll,	E.M.,	Woodbury, N. J.
Straub, Lewis Boyd,	Bus.,	Los Angeles, Cal.
Strawn, Eli Howard,	C.E.,	Quakertown.
Sutherland, Falkner,	Bus.,	LeRoy, N. Y.
Swartley, John Cassel, jr.,	B.A.,	Doylestown.

Swartz, Ralph Christian,	M.E.,	Allentown.
Talmage, Herbert Richard,	C.E.,	Irvington, N. J.
Thayer, James Stansbury,	M.E.,	Baltimore, Md.
Thompson, Edward King,	M.E.,	Pittsburgh.
Thompson, Walter Scott,	E.E.,	Sunbury.
Tilghman, Richard Haughton,	M.E.,	Overlea, Md.
Tinsman, Howard Riegel,	M.E.,	Phillipsburg, N. J.
Tonking, Russell,	Ch.E.,	Dover, N. J.
Tremaine, Lawrence,	M.E.,	Buffalo, N. Y.
Troland, Hugh Moore, jr.,	C.E.,	Philadelphia.
Troutman, Roy Ezra,	Ch.E.,	Bethlehem.
Tuggey, John Mitchell, jr.,	B.A.,	Bethlehem.
Underwood, Lloyd Fletcher,	Ch.E.,	Chatham, N. J.
Underwood, Ralph Edward,	B.A.,	Brooklyn, N. Y.
Urban, Stanley Joseph,	E.M.,	Allentown.
Van Dyke, John Harrison,	M.E.,	Pittsburgh.
Walter, Ephraim Kenneth,	Bus.,	Brooklyn, N. Y.
Warriner, Ruel Dexter,	E.M.,	Philadelphia.
Wasser, Floyd Henry,	Met.,	Bethlehem.
Watkins, John Edward,	M.E.,	Hazleton.
Wehrenberg, William, jr.,	E.E.,	Baltimore, Md.
Wentz, Graham,	Ch.E.,	Scranton.
White, Charles McCrea,	C.E.,	Wilmington, Del.
White, Henry Carleton,	Met.,	Buffalo, N. Y.
Wiegner, Andrew Newton,	C.E.,	Bethlehem.
Wigfall, Edward Newton, jr.,	B.A.,	Cynwyd.
Wing, Francis Henry,	Bus.,	Boston, Mass.
Wise, James Andrew,	B.A.,	Hopeville, Ga.
Wood, Arthur,	B.A.,	Providence, R. I.
Wood, Charles Bradley,	N.E.,	Pittsburgh.
Woodford, Walter Fletcher,	E.E.,	Nutley, N. J.
Woodrow, Maurice Orr,	C.E.,	Wilkes-Barre.
Woodridge, William Potter,	E.M.,	Pittsburgh.
York, Elbert Hower,	E.E.,	Scranton.
York, Warren Webster,	Bus.,	Scranton.
Yuang, Tung,	E.M.,	Pekin, China.
Yundt, George Edward,	E.M.,	Allentown.
Zannaras, John Philippe,	N.E.,	Chios, Greece.

FRESHMAN CLASS

Class of 1925

	Course	Residence
Abel, David Heaton,	B.A.,	Philadelphia.
Adams, Robert Burnette,	Bus.,	Brockton, Mass.
Akialis, Joseph Michael,	Ch.E.,	Newark, N. J.
Alden, Leland Milton,	Ch.E.,	Washington, D. C.
Allen, Charles Wesley,	E.M.,	Reading.
Anderson, Robert Wilson,	E.M.,	Philadelphia.
Angulo, David,	C.E.,	Barranquilla, Colombia, S. A.
Arnold, John Philip,	E.E.,	Harrisburg.
Arthurs, Biddle, jr.,	E.E.,	Pittsburgh.
Astarita, Francis Sandford,	Bus.,	Loch Arbor, N. J.
Austin, James Bliss,	Ch.E.,	Chicago, Ill.
Ayres, Clarence Cornelius,	E.E.,	Chester.
Ayres, Elwood Bowers, jr.,	M.E.,	Melrose Park.
Bailey, Guy Wesley,	Ch.E.,	Nicholson.
Balis, Otis Wanton,	Bus.,	Philadelphia.
Barnes, John Francis,	E.M.,	New Paltz, N. Y.
Barton, Frederick Charles, jr.,	B.A.,	New York, N. Y.
Batz, Kenneth William Yates,	M.E.,	Stapleton, N. Y.
Bayles, Allison Lerch,	M.E.,	Charleston, S. C.
Beck, Frederick Charles,	E.E.,	Philadelphia.
Bedell, Herbert Groy,	Bus.,	East Orange, N. J.
Beggs, Charles Wendell,	Ch.E.,	Wilkinsburg.
Behr, William John, jr.,	N.E.,	Montclair, N. J.
Bergen, Lewis Spaden,	E.M.,	Matawan, N. J.
Berger, Francis Joseph,	E.E.,	Wilkes-Barre.
Bevan, James Elmer,	E.E.,	Frackville.
Binkley, Edward Lehman,	E.E.,	Hagerstown, Md.
Bissinger, John Abraham, jr.,	M.E.,	Harrisburg.
Boehm, Philip Daniel, jr.,	M.E.,	Aldan.
Bohlen, Edward Raymond,	Bus.,	Allentown.
Bokum, William Harold,	E.E.,	Philadelphia.
Bole, John Clark, jr.,	E.E.,	Philadelphia.
Borda, Russell Berger,	Bus.,	Schuylkill Haven.
Borden, Robert Oswald,	M.E.,	Bentonville, Va.
Bowman, John Gheen,	C.E.,	Bethlehem.
Boyce, William Rapilje, jr.,	E.M.,	Ridgewood, N. J.

Bradley, Frederick William,	C.E.,	Trenton, N. J.
Bricker, William Paul,	C.E.,	Philadelphia.
Brinser, Donald Christian,	Ch.E.,	Harrisburg.
Britt, Therman Paul,	Bus.,	Rydal.
Brookover, Andrew Jackson,	M.E.,	East Downingtown.
Brookover, Robert Shelton,	M.E.,	East Downingtown.
Brooks, Charles Emery,	Bus.,	Glen Ridge, N. J.
Brown, Ernest Embich,	E.E.,	Lebanon.
Brown, Merritt Weaver,	B.A.,	Bethlehem.
Bunn, George William,	B.A.,	East Stroudsburg.
Burke, Edmund Michael,	C.E.,	West Pittston.
Burlingame, Gordon Matthew,	M.E.,	Bryn Mawr.
Burton, John Taylor,	C.E.,	Philadelphia.
Callow, Michael John,	Met.,	Salt Lake City, Utah.
Campbell, Andrew Hiester,	C.E.,	Pottstown.
Canning, Robert Ashton,	C.E.,	Bethlehem.
Carr, James Aloysius,	Bus.,	Philadelphia.
Carr, Oliver Taylor,	M.E.,	Washington, D. C.
Castleman, Francis Lee, jr.,	B.A.,	Philadelphia.
Chambers, Harold Bair,	Met.,	Lancaster.
Cheel, Robert Duncan,	M.E.,	Ridgewood, N. J.
Childs, Frank Lawton,	Bus.,	New York, N. Y.
Childs, James Lawton,	Bus.,	New York, N. Y.
Chiles, Franklin Groman,	N.E.,	Bethlehem.
Clark, John Willard,	Bus.,	Merion.
Coffin, George Francis, jr.,	M.E.,	Easton.
Cohen, Milford Hersh,	Ch.E.,	Charleston, W. Va.
Colburn, Walter Hixson,	Bus.,	Phillipsburg, N. J.
Colclough, William Frederick, jr.,	B.A.,	Catasauqua.
Coleman, Gerald Douglas,	B.A.,	Honesdale.
Collins, Paul Wiedner,	C.E.,	Bethlehem.
Cook, Isaac Samuel Annan,	B.A.,	Bethlehem.
Cook, Nevin John,	B.A.,	Drums .
Cottrell, Joseph Donald,	Ch.E.,	Takoma Park, D. C.
Coulton, John Marshall,	C.E.,	Red Bank, N. J.
Cox, Marvin Ellsworth,	N.E.,	Camden, N. J.
Craig, John Horner,	Ch.E.,	Slatington.
Crawford, Frederick Rufus,	E.M.,	Pittsburgh.
Croll, John Harold,	E.M.,	Steelton.
Curtis, Edward Aloysius,	E.E.,	Lambertville, N. J.

Daggett, Eldred Herbert,	Ch.E.,	Brooklyn, N. Y.
Dalgleish, Robert Hamilton, jr.,	M.E.,	Washington, D. C.
Daly, Thomas Francis,	Bus.,	New York, N. Y.
Dannerth, Carl Alexander,	E.E.,	Ashbourne.
Davis, James Hornor, 2nd,	B.A.,	Clarksburg, W. Va.
Davis, Richard Light,	E.M.,	Lebanon.
Day, Hugh Taylor,	B.A.,	Philadelphia.
Deck, Ausben Riege,	Ch.E.,	Takoma Park, D. C.
Dillingham, Conway Cowan,	E.M.,	Baltimore, Md.
Dinkey, Charles Eugene, jr.,	E.M.,	Pittsburgh.
Dorsett, James Howard,	M.E.,	Glendale, Md.
Dorton, Frederick Babcock,	B.A.,	Baltimore, Md.
Drury, William George,	C.E.,	West Pittston.
Dubin, Maurice,	E.E.,	Allentown.
DuBois, Allen Corson,	B.A.,	Clayton, N. J.
Dykes, Henri Victor de Puis,	B.A.,	Bethlehem.
Eckfeldt, James Trousselle,	Bus.,	Bethlehem.
Egolf, Harry Louis, jr.,	E.M.,	Philadelphia.
Eisenhower, James Russell,	E.E.,	Frackville.
Elicker, Charles Robert,	B.A.,	May's Landing, N. J.
Elmer, Robert William,	E.E.,	Bridgeton, N. J.
Emmons, Robert James,	B.A.,	Bridgeport, Conn.
Entrekin, Paul Britton,	E.E.,	Claymont, Del.
Erickson, Solomon Gerald,	Bus.,	Cleveland, O.
Everhart, John Lawrence,	Ch.E.,	Bethlehem.
Ewart, Roswell Horr,	Ch.E.,	North Plainfield, N. J.
Ewing, Edward Guth,	B.A.,	Bethlehem.
Finegan, Paul James,	B.A.,	Burlington, N. J.
Fister, Lee Harold,	E.E.,	Reading.
Flory, Curtis Bertram, jr.,	Bus.,	Forest Hills, N. Y.
Fordham, Chester W.,	M.E.,	Easton.
Forsyth, William Redway,	C.E.,	Trenton, N. J.
Fullard, William George,	B.A.,	Beverly, N. J.
Gairns, William Otto,	Ch.E.,	La Grange, Ill.
Gibson, Kenneth Durward,	Bus.,	Belleville, N. J.
Gilmour, Douglas Wilkinson,	Bus.,	Philadelphia.
Glenn, Joseph Wooderson, jr.,	E.M.,	Garden City, N. Y.
Gold, Chauncey,	Bus.,	Brooklyn, N. Y.
Goldstein, Samuel,	B.A.,	Atlantic City, N. J.
Gondos, Robert Zoltan,	Ch.E.,	Reading.

Graul, Carl Morgan,	B.A.,	Lehighton.
Green, Thomas Edgar,	Bus.,	Butler.
Greene, Henry Eckford, jr.,	Bus.,	Amsterdam, N. Y.
Greer, William Chamberlain, jr.,	Bus.,	Woodbury, N. J.
Groner, Stephen Sheldon,	Bus.,	Syracuse, N. Y.
Gruhn, Arthur Max,	Bus.,	Brooklyn, N. Y.
Gyourko, Joseph Edward,	M.E.,	Eckley.
Hardie, James Heller,	Bus.,	Pittsburgh.
Harmon, Herbert Greasen,	B.A.,	Ridgewood, N. J.
Harms, Arthur Gustav,	E.M.,	Flushing, N. Y.
Harris, John Edward,	Bus.,	Bethlehem.
Hart, Benjamin Franklin, 3rd,	N.E.,	New York, N. Y.
Hartwell, Moreland Tremayne,	B.A.,	Pittsburgh.
Harwi, Wilbur Gladstone,	B.A.,	Hellertown.
Havens, James Curtis,	N.E.,	Bridgeport, Conn.
Hay, Erroll Baldwin, jr.,	M.E.,	Philadelphia.
Heilman, Clark Austin,	E.E.,	Lebanon.
Hendershott, Harold Clark,	Bus.,	Newton, N. J.
Henry, Gerald Boyd,	Bus.,	Buffalo, N. Y.
Herman, Morgan Frederic,	E.M.,	Middletown, N. Y.
Hess, Howard Samuel, jr.,	Bus.,	Hellertown.
Hoffa, John Edward,	Bus.,	Wilkes-Barre.
Holzshu, Charles David,	E.E.,	Cumberland, Md.
Hontz, Maurice Wilson,	E.E.,	Summit Hill.
Horn, Franklin Lefever,	Bus.,	Allentown.
Howland, George Asbury,	Ch.E.,	Asbury Park, N. J.
Hubbard, Sheldon Crouter,	E.M.,	Bradentown, Fla.
Hunt, Robert Church,	M.E.,	New York, N. Y.
Hursh, James Sharpe,	N.E.,	Newville.
Hutchinson, Stuart Buckler,	C.E.,	Bethlehem.
Ingols, Heber Ashe,	Ch.E.,	Newark, N. J.
Isaacs, Kenneth Lothaire,	M.E.,	Scranton.
Jaycox, Jack Melvin,	M.E.,	McKeesport.
Jewell, Charles Demore,	B.A.,	Bethlehem.
Johnson, Stuart Curtis, jr.,	M.E.,	Washington, D. C.
Jones, David John,	E.E.,	Strong.
Jones, Edward Rosser,	Bus.,	Rochester, N. Y.
Jones, Edwin Pitchford, 2nd,	Bus.,	Bellevue.
Jones, Harold Franklin,	M.E.,	Camptown.
Jones, William Joseph, jr.,	E.M.,	Narberth.

Keating, Miles James,	Bus.,	Bethlehem.
Keck, Kenneth Kerwin,	E.E.,	Allentown.
Keim, John Kenneth,	M.E.,	Bethlehem.
Kelchner, John Wilson, jr.,	C.E.,	Berwick.
Keller, Francis Randolph,	M.E.,	Allentown.
Kendall, Charles Joseph,	Bus.,	Washington, D. C.
Kerr, Harry Knight,	Ch.E.,	Philadelphia.
King, Arthur Stanley,	M.E.,	Toms River, N. J.
Kingham, Laurence Brewster,	Bus.,	East Orange, N. J.
Kinzie, Raymond Horatio,	C.E.,	Tamaqua.
Kittinger, Spencer Colie,	Bus.,	Buffalo, N. Y.
Kloster, Theodore Milbury,	M.E.,	Brooklyn, N. Y.
Koegler, George Franz,	B.A.,	New York, N. Y.
Krazinski, Leo Charles K.,	E.E.,	Mahanoy City.
Krellberg, Alfred,	Bus.,	New York, N. Y.
Kroenke, Alfred Hubert,	Bus.,	Cleveland, O.
Lambert, Ralph Arthur,	M.E.,	Bethlehem.
Lang, Elheim,	Ch.E.,	Phoenixville.
Larkin, Schuyler Van Cleef,	E.M.,	Plattsburg, N. Y.
Latimer, Robert Cary,	M.E.,	Washington, D. C.
Law, James Graham,	Ch.E.,	Bloomsburg.
Lawall, Paul,	E.M.,	Catasauqua.
Leavens, William Barry, jr.,	E.E.,	Maplewood, N. J.
Leavitt, Lyman Miller,	Bus.,	Trenton, N. J.
Lee, Russell Werner,	Ch.E.,	Ottawa, Ill.
Leib, James Fulton,	Bus.,	Baltimore, Md.
Lerch, Franklin Stuart,	B.A.,	Freemansburg.
Leshefka, George John,	E.E.,	McAdoo.
Levitz, Max,	Bus.,	New York, N. Y.
Levy, Maurice Bert,	Met.,	Hazleton.
Lewis, Robert,	Bus.,	New York, N. Y.
Loyd, William Fisher,	E.E.,	Gary, Ind.
Ludwig, Edward Henry Berthold,	Ch.E.,	New York, N. Y.
Lund, Carl Adolph,	M.E.,	Berlin, Conn.
MacFate, Robert Preston,	Ch.E.,	Bethlehem.
McCready, Robert Clark,	B.A.,	Summit Hill.
McDermott, James Francis,	Bus..	New York, N. Y.
McFarlan, Alden Irving,	M.E.,	Bayonne, N. J.
McKee, John Edwin,	Ch.E.,	Newport.
McKenzie, Alfred Crane,	N.E.,	Brooklyn, N. Y.

McMorris, William Barnhart,	C.E.,	Harrisburg.
McNamara, Lawrence William,	Bus.,	Warren.
McWilliams, Charles Anthony Sinclair,	N.E.,	New York, N. Y.
Maginsky, William Alexander Joseph,	B.A.,	Ashley.
Malis, Pincus Robert,	Bus.,	New York, N. Y.
Malloy, Louis Joseph,	M.E.,	Shenandoah.
Mann, Lynn Birckhead,	Bus.,	Woodcliff, N. J.
Martin, Harold Christian,	Ch.E.,	Hazleton.
Matthews, Armstrong Robertson,	E.M.,	Nashville, Tenn.
Mayberry, Harold,	Bus.,	Mahanoy City.
Mears, Richard Ord,	E.M.,	McElhattan.
Mellinger, Edward Roscoe,	Bus.,	Lancaster.
Metten, William Murray,	Bus.,	Wilmington, Del.
Meyer, William Charles,	C.E.,	Hazleton.
Meyers, William Earl,	E.E.,	East Stroudsburg.
Michelson, Joseph Percy,	B.A.,	Bethlehem.
Miller, Gordon Blair,	Bus.,	Huntingdon.
Miller, Henry Robert,	E.E.,	Reading.
Miller, Howard Frederick,	M.E.,	Easton.
Mohr, Robert Landis,	B.A.,	Coopersburg.
Moran, Eugene Francis, jr.,	N.E.,	Brooklyn, N. Y.
Moreland, Lester Duane,	M.E.,	Trenton, N. J.
Moritz, George Robert,	Met.,	Allentown.
Nauman, Carl Arnold,	E.E.,	Stroudsburg.
Neely, Frank Rodgers,	B.A.,	Pittsburgh.
Nehemiah, Maurice Albert,	Ch.E.,	Brooklyn, N. Y.
Newhard, Paul Aaron,	Bus.,	Northampton.
Nichol, John McCartle Dunagee,	E.E.,	Staunton, Va.
Nicola, Oliver Peter, jr.,	E.M.,	Pittsburgh.
Noerr, Robert Collyer, jr.,	Ch.E.,	Hartford, Conn.
Norton, Robert Osgood,	C.E.,	South Orange, N. J.
Oates, Robert Luther,	M.E.,	Tarrytown, N Y.
O'Brien, William Coleman,	E.E.,	Washington, D. C.
Ochse, George Henry,	C.E.,	Ambler Highlands.
Ogden, John Boyd,	M.E.,	Johnstown.
Oliver, Manuel,	M.E.,	Antilla, Cuba.
Olwine, John Clayton,	Ch.E.,	Newark, N. J.
O'Neill, John Francis,	B.A.,	Turtle Creek.

Orr, Earl Haas,	Met.,	Lansdale.
Oswald, Harold Samuel,	E.E.,	Lehighton.
Palmer, Arthur Carl,	C.E.,	East Orange, N. J.
Palmer, Herbert William,	B.A.,	Pen Argyl.
Paret, George Lock,	Bus.,	Lake Charles, La.
Parker, Norman Douglas, jr.,	E.E.,	Washington, D. C.
Pasayiotis, George Nikola,	E.E.,	Reading.
Patrick, Paul David,	E.E.,	Philadelphia.
Pharo, Homer Durand,	Ch.E.,	Bayonne, N. J.
Philips, Harry Kenneth,	Bus.,	Glen Ridge, N. J.
Phillips, Lockwood,	B.A.,	Pittston.
Pierson, Albert Closson,	Bus.,	Lititz.
Pineda, Luis Guillermo,	E.E.,	Maracaibo, Venezuela.
Pittenger, Harry Joseph,	E.M.,	Bethlehem.
Pitts, Reginald Shatswell,	Chem.,	Hanover.
Platt, Worthington Elmore,	E.M.,	New Haven, Conn.
Podmajersky, John Edward,	E.E.,	Lansford.
Porter, Clarence Henry,	M.E.,	Washington, D. C.
Purdy, Victor Moreau,	Met.,	Brooklyn, N. Y.
Rankin, Bryant Loose,	Met.,	Reading.
Ransom, James Dudley,	B.A.,	Jersey City, N. J.
Raught, Roland Davis Jones,	M.E.,	Lewes, Del.
Reid, William Alexander,	M.E.,	Glen Ridge, N. J.
Reynolds, John Bernard,	B.A.,	Bethlehem.
Rich, Herbert William,	Ch.E.,	East Orange, N. J.
Richards, Donald Howell,	E.E.,	Scranton.
Rindlaub, Willard Weaner,	E.E.,	East Downingtown.
Ritter, Samuel Henry,	Bus.,	Easton.
Roberts, Carlton Mitchell,	C.E.,	Asbury Park, N. J.
Roberts, Paul Eagon,	B.A.,	Parkersburg, W. Va.
Robinson, Richard Stuart,	E.E.,	Philadelphia.
Roecker, Earl Edward,	E.M.,	Phillipsburg, N. J.
Roesch, Alfred Richard,	Ch.E.,	Jenkintown.
Rorabaugh, Merrill Schaeffer,	E.E.,	New Kensington.
Ross, Rodney Wyckoff,	Bus.,	Asbury Park, N. J.
Roth, Milton Samuel,	C.E.,	Butler.
Rowley, Thomas Clarence,	M.E.,	New York, N. Y.
Rutherford, William Sumner, jr.,	E.M.,	Bethlehem.
Sare, George Harold,	B.A.,	Denver, Col.
Saxtan, Eugene Harris,	Bus.,	Jersey City, N. J.

Schmoll, Gilbert Henry,	Ch.E.,	Hazleton.
Schneider, Robert Siis,	M.E.,	Richmond Hill, N. Y.
Schock, Harvey H.,	Ch.E.,	Shartlesville.
Schwadron, Julius Jay,	Bus.,	New York, N. Y.
Seeley, Robert Inglis,	C.E.,	Keansburg, N. J.
Senior, Palmer Newman,	E.M.,	Bridgeport, Conn.
Serrell, Arthur Harold, jr.,	M.E.,	Brooklyn, N. Y.
Sharp, Francis Hort,	C.E.,	Bridgeton, N. J.
Shartle, John Herbert,	C.E.,	Lancaster.
Shaw, Alexander Wilson, jr.,	Chem.,	Bethlehem.
Sheidon, Alan Forbes,	M.E.,	New Rochelle, N. Y.
Sholes, Charles Latham,	Bus.,	Short Hills, N. J.
Siebert, John Carl,	Met.,	Coopersburg.
Siegmund, Harry Loew,	Ch.E.,	Harrisburg.
Silsby, Howard Wiswell,	Ch.E.,	Washington, D. C.
Singley, Raymond Clifford,	E.M.,	Mount Carmel.
Sipple, Carl Schultz,	B.A.,	Allentown.
Smith, Edmond Arthur Hartley,	M.E.,	New York, N. Y.
Smith, Morris Sparhawk,	M.E.,	Swarthmore.
Smith, Walter Reynolds,	M.E.,	Carbondale.
Snyder, Martin Edgar,	Bus.,	Plainfield, N. J.
Spalding, Fitzhugh Preston,	M.E.,	Marquette, Mich.
Spencer, Edmund Charles,	E.E.,	Stamford, Conn.
Stahl, Harry Ernest, jr.,	E.E.,	Trenton, N. J.
Stapowich, Joseph Paul,	C.E.,	Hazleton.
Stauffer, Willis Keiter,	Bus.,	Bethlehem.
Stazinski, Peter Felix,	M.E.,	Plymouth.
Storer, John Waddell, jr.,	Bus.,	Wheeling, W. Va.
Stott, Frank Janney,	Bus.,	Philadelphia.
Stover, Arthur Platt,	Ch.E.,	Wilmington, Del.
Stratton, Sylvern Eugene,	E.E.,	Vineland, N. J.
Sweisford, John O'Neill,	E.E.,	Pottstown.
Taylor, Charles Gibson,	E.E.,	Pittsburgh.
Taylor, Louis Richmond,	E.E.,	Vineland, N. J.
Taylor, Robert Sayre, jr.,	B.A.,	Bethlehem.
Taylor, Thomas Frederic,	C.E.,	Bangor.
Thompson, Edward Franklin,	Bus.,	Sewickley.
Thompson, Wilmer Snover,	E.E.,	Bayonne, N. J.
Thornburg, Richard Beaumont,	B.A.,	Bethlehem.
Thropp, James West,	B.A.,	Morrisville.

Timmons, Morris Massey,	M.E.,	Berlin, Md.
Titus, Charles Fischer,	B.A.,	Closter, N. J.
Trumbore, Clark Richard,	B.A.,	Bethlehem.
Trushel, Willard Carl,	B.A.,	Warren.
Turnbach, Edward Anthony,	Met.,	West Pittston.
Tyler, Walter Simeon, jr.,	Ch.E.,	Bridgeport, Conn.
Unkles, John Jacob,	Bus.,	East Orange, N. J.
Vail, Robert Simon,	Bus.,	Plainfield, N. J.
VanBuskirk, Thomas Samuel,	M.E.,	Doylestown.
VanDenburgh, Albert Stevens, jr.,	M.E.,	North Plainfield, N. J.
VanNostrand, Erwin Skidmore, jr.,	M.E.,	Toms River, N. J.
Verlenden, John Boyd,	C.E.,	Darby.
Verner, Alfred Howard,	Bus.,	Coraopolis.
Visintainer, Alfred Alexander,	C.E.,	Mount Carmel.
Volkmar, Karl,	C.E.,	Williamsport.
Waldron, John Wesley,	Ch.E.,	Philadelphia.
Walker, Ralph Harold,	E.M.,	Catasauqua.
Walker, William Higham,	Bus.,	Riverton, N. J.
Wallace, Kenneth Campbell,	Ch.E.,	Bridgeport, Conn.
Wallin, Carl Jorgan,	M.E.,	Hot Springs, Va.
Waltman, John Richard,	E.M.,	Bethehem.
Wardell, Weston Burnet,	Bus.,	East Orange, N. J.
Washburn, Lindsley Morgan,	M.E.,	Wilkes-Barre.
Weier, Thomas Elliot,	BA.,	Flushing, N. Y.
Weiss, Harold Kenneth,	B.A.,	Wilkes-Barre.
Weissenborn, Albert Edward,	E.E.,	Montclair, N. J.
Welch, Hiester Jacob,	N.E.,	Elmira, N. Y.
Wettereau, Paul Christian,	Ch.E.,	Hazleton.
Wheeler, Charles Earl,	Bus.,	New York, N. Y.
Wheeler, Robert Samuel,	C.E.,	Allentown.
Wheelock, Richard Lincoln,	C.E.,	New York, N. Y.
Williams, Laurens Augustine Peter,	E.E.,	Woodstock, Vt.
Wilmot, George Lincoln,	M.E.,	Hazleton.
Wilson, Kenneth Erwin,	B.A.,	Barton, N. Y.
Wilson, Robert Arthur,	N.E.,	Tacoma, Wash.
Wisotzkey, Harry Albert, 2nd,	E.E.,	York.
Wolcott, Leslie Carl,	E.E.,	Warren, O.
Wood, Tyler Duchardt,	M.E.,	South Norwalk, Conn.
Wright, Kenneth Arden,	C.E.,	Williamsport.

SPECIAL STUDENTS

	Course	Residence
Atkins, Charles Miner,	Met.,	Pottsville.
Bonnemaison, Marcelo de Elias,	E.M.,	Buenos Aires, Rep. Argentina.
Burgess, George Paul,	Bus.,	Chicago, Ill.
Carey, C. H.,	B.A.,	Mauch Chunk.
Fernandez, Carlos Alberto,	E.M.,	Buenos Aires, Rep. Argentina.
Finley, Harry James,	Bus.,	Harrisburg.
Johnson, Benjamin Roger,	Bus.,	Long Beach, Cal.
Kinsey, Irwin Zipp,	B.A.,	Souderton.
Liang, Pei Yin,	E.M.,	Changsha, China.
Lund, Gosse Clarence,	B.A.,	Berlin, Conn.
Ma, Chien Chung,	Ch.E.,	Amoy, China.
Miller, Harry Bachman,	Bus.,	Bethlehem.
Morgan, William John,	Bus.,	Bethlehem.
Munakata, Tameharu,	E.M.,	Osaka, Japan.
Osborne, Mortimer Hamilton,	Bus.,	Wilmington, Del.
Parlour, Clarence Henry,	B.A.,	Allentown.
Patton, Edward Thomas,	M.E.,	Philadelphia.
Petersen, Thoralf Roh,	N.E.,	Bethlehem.
Potts, George Eckert,	Bus.,	Reading.
Rabinovitz, Simcha,	B.A.,	Brooklyn, N. Y.
Ricapito, Joseph,	B.A.,	Philadelphia.
Shen, Dzu-Kun,	Ch.E.,	Hankow, China.
Wurster, Luther Conrad,	E.E.,	Harrisburg.
Ziegenfuss, Charles Edwin,	Bus.,	Bethlehem.

STUDENTS IN EVENING SCHOOL OF BUSINESS ADMINISTRATION

The following list includes non-matriculated students who are pursuing courses in the Evening School of Business Administration, described on pages 130-132. The courses in which the students are enrolled are indicated by numbers: 1, Business law; 2, Banking and Currency; 3, Accounting; 4, Economics; 5, Corporation Law; 6, Corporation Accounting; 7, Business Finance; 8, Political Science.

NAME	COURSE	RESIDENCE
Achey, Howard Addison,	1, 3, 8	Bethlehem.
Amrhein, Irving S.,	1, 3, 8	Bethlehem.
Anderson, Howard L.,	1, 3, 8	Bethlehem.
Bader, Harry Walker,	6, 7, 8	Bethlehem.
Baer, John George,	1, 3, 8	Allentown.
Bieber, Truman I.,	3, 8	Bethlehem.
Birk, Robert M.,	1, 3, 8	Bethlehem.
Brady, Frank J.,	1, 3, 8	Bethlehem.
Brendle, Herman D.,	1, 3	Bethlehem.
Brown, William,	1, 3, 8	Bethlehem.
Buck, Harry William,	1, 3, 8	Bethlehem.
Clauser, Edgar R.,	1, 3, 8	Bethlehem.
Cota, Norman Dewart,	1, 3, 8	Bethlehem.
Didriksen, Philip Henry,	5, 8	Bethlehem.
Ditterline, Roy E.,	6, 7, 8	Bethlehem.
Diehl, George C.,	1, 3, 8	Bethlehem.
Doggett, Egbert B., C.E., (*Washington and Lee University*)	5, 6, 7, 8	Bethlehem.
Drake, George E.,	1, 3, 8	Bethlehem.
Eberhart, Isaac K.,	5, 6, 7, 8	Bethlehem.
English, Willard R.,	3, 8	Bethlehem.
Evans, Thomas Charles,	1, 3, 8	Bethlehem.
Everett, LeRoy Charles,	1, 3, 7, 8	Bethlehem.
Faga, Ralph C.,	1, 7, 8	Bethlehem.
Felker, William H.,	6, 7, 8	Bethlehem.
Fleischman, Ernest C.,	1, 8	Bethlehem.
Gasda, Stephen A.,	6, 7, 8	Bethlehem.
Gerfin, C. Stanley,	1, 8	Bethlehem.
Gordin, George,	7	Allentown.
Green, Adam A.,	1, 3, 8	Bethlehem.
Haehnle, Edward D.,	5, 7, 8	Bethlehem.
Herstine, Augustus E.,	1, 3, 8	Bethlehem.
Hursh, John Jacob,	1, 3, 8	Bethlehem.
Hutchinson, Andrew James,	1, 3, 8	Bethlehem.
Jacobs, Charles E.,	1, 3, 8	Bethlehem.
Kanuck, John A.,	6, 7, 8	Bethlehem.
Keck, Norwood R.,	1, 3, 8	Bethlehem.
Kilpatrick, Laurence A.,	5, 7, 8	Bethlehem.
Knies, John D.,	1, 3, 8	Bethlehem.
Kunkel, Luther G. N.,	5, 6, 7, 8	Allentown.

McLay, Thomas Atkinson,	1, 3, 8	Bethlehem.
Lichty, Herman J.,	1, 3, 8	Bethlehem.
Machado, José A., jr., A.B., (*Harvard University*)	6, 7, 8	Bethlehem.
Mack, Clarence C.,	1, 7, 8	Bethlehem.
Miller, Edward Frederick,	1, 3, 8	Bethlehem.
Morrison, Joseph J.,	1, 3, 8	Bethlehem.
Nicholas, Robert Sterner,	3, 8	Bethlehem.
Rafferty, Eugene Joseph,	1, 3, 8	Allentown.
Reider, W. Freeman,	1, 3, 8	Bethlehem.
Ruyak, George Joseph,	6, 7, 8	Bethlehem.
Schaeffer, R. Paul,	1, 3, 8	Allentown.
Seiders, Ralph Ray,	1, 3, 8	Bethlehem.
Sellers, George E.,	1, 7, 8	Bethlehem.
Smith, McNeir,	1, 3, 8	Bethlehem.
Smith, Samuel R.,	6, 7, 8	Bethlehem.
Stewart, Harry Hunt,	3, 8	Bethlehem.
Stine, Harry R.,	1, 3, 8	Bethlehem.
Trageser, Paul Adam,	1, 7	Bethlehem.
Walker, Eugene B.,	1, 3, 8	Allentown.
Wallower, Clarence I.,	1, 3, 8	Bethlehem.
Wannamacher, Paul St. Clair,	1, 3, 8	Bethlehem.
Weikel, Charles Henry Harrison,	1, 3, 8	Bethlehem.
Youngken, Harold H. N.,	1, 7	Allentown.

STUDENTS IN EXTENSION COURSES

The following list includes non-matriculated students who are pursuing collegiate or postgraduate courses from among those listed on pages 125-130 of this Register. In addition, candidates for the Master's degree who have also enrolled in such extension classes are included in the list of extension students.

The courses in which the students are enrolled are indicated by numbers as follows: 1. General Biology; 2. Contemporary English Literature; 3. Curriculum Making; 4. Demonstration Class; 5. Economics; 6. Education of Subnormal Children; 7. Elementary Education; 8. Educational Measurement; 9. Advanced French; 10. Geology; 11. History of Education; 12. History of Philosophy; 13. Mental Diagnosis; 14. Physics; 15. Project Method; 16. School Administration; 17. Secondary

Education; 18. Social Psychology; 19. Elementary Spanish; 20. Speech Correction in the Public Schools; 21. Physical Geology; 22. Historical Geology.

SUMMER SESSION, 1921

	Course	Residence
Bishop, Louise Antoinette, A.B.,	6, 13,	Bethlehem.
Boehm, Charles H.,	5, 16, 17,	Hellertown.
Boyd, Maude Willey,	6, 13,	Hinton, W. Va.
Buckley, Margaret Green,	6, 13,	Hartford, Conn.
Burke, Loretta M.,	6, 13,	Meriden, Conn.
Cathcart, Cleora A.,	6, 13,	Hammonton, N.J.
Chambers, Minnie B.,	6, 13,	McKeesport.
Clark, Andrew G.,	6, 13,	Austin, Tex.
Cummings, Ruby M.,	6, 13,	Decatur, Ill.
Dougherty, Margaret Grace,	6, 13,	Ashland.
Doyle, Theresa A.,	6, 13,	Fort Wayne, Ind.
Dwyer, Mary M.,	4, 8,	Bethlehem.
Fetherolf, Martin D., A.B., (*Muhlenberg College*)	16, 17,	Allentown.
Fleming, Helen,	6, 13,	Pigna, O.
Forry, Ada M.,	6, 13,	Columbia.
Galvin, Nellie A.,	6, 13,	Waterbury, Conn.
Gerken, Cora Marie,	13,	Dayton, Wash.
Graham, Marion Bartley,	4, 5, 15,	Bethlehem.
Gwin, Florence M.,	6, 13,	Altoona.
Hall, Ruth,	6, 13,	Red Bank, N. J.
Hedding, Margaret M.,	6, 13,	Altoona.
Hefferman, John Kinsey,	11, 15, 17,	Easton.
Hillard, Barbara E.,	6, 13,	Harrisburg.
Howe, Helen Miller,	6, 13,	Omaha, Neb.
Jones, Elsie M.,	4, 16,	Easton.
Kressler, Raymond H., A.B., (*Muhlenberg College*)	8, 15,	Allentown.
Laury, Joseph Ellis,	16, 17,	Bethlehem.
Lucas, Mary I'On,	6, 13,	Savannah, Ga.
Lyford, Emmita,	6, 13,	Dayton, O.
McMahon, Elizabeth,	6, 13,	Wilkes-Barre.
McMaster, Agnes Rice,	6, 13,	Columbia, S. C.
Meigs, Eunice Mary,	6, 13,	Madison, Conn.
Miller, Myrtle Eileen,	6, 13,	Lincoln, Kan.

Pohl, Elizabeth Shimer,	4, 5, 15, 16,	Easton.
Smith, Matthew John Adam, B.S., (*Franklin and Marshall College*)	15, 16, 17,	Coopersburg.
Strother, Elizabeth Bradley,	6, 13,	Crosswicks, N. J.
Tassin, Yolande,	6, 13,	New Orleans, La.
Tatnal, Edna Grace, A.B., (*Pennsylvania College for Women*)	5, 16, 17,	Harrisburg.
Tatro, Dora L.,	6, 13,	Holyoke, Mass.
Twiner, Helen F.,	6, 13,	Camden, N. J.
Vail, Grace Elizabeth,	6, 13,	Danbury, Conn.
Viana, Mary M.,	6, 13,	Vineland, N. J.
Weede, Kittie,	6, 13,	Topeka, Kan.
Whitney, Sarah May,	6, 13,	Fitchburg, Mass.
Yahraes, Emily,	6, 13,	Easton.
Yepsen, Lloyd N.,	6, 13,	Vineland, N. J.

FIRST TERM, 1921-1922

	Course	Residence
Adams, Isabel,	20,	Philadelphia.
Albert, Ruth,	20,	Philadelphia.
Aller, Lillie A.,	7,	Bethlehem.
Althouse, Laura M.,	20,	Philadelphia.
Amrheim, Virginia,	12,	Bethlehem.
Amman, Mabel A.,	20,	Philadelphia.
Ancona, Marion Cleaver,	20,	Philadelphia.
Arntzen, Ella M.,	19,	Bethlehem.
Atherton, Flora,	9,	Harrisburg.
Babcock, Mary Kirk,	2, 18,	Bethlehem.
Bachman, Charles C., A.B., (*Muhlenberg College*)	20,	Allentown.
Bachman, Jennie,	20,	Allentown.
Bachman, Matilda E.,	20,	Allentown.
Backensto, Lloyd B.,	7,	Emaus.
Bahan, Sarah P.,	20,	Philadelphia.
Barber, Gertrude E.,	20,	Philadelphia.
Barnhart, Mrs. Eva Rees,	7,	Lebanon.
Barnhart, Katherine,	7,	Lebanon.
Bartholomew, I. H.,	2,	Bethlehem.
Becker, Carrie A.,	7,	Emaus.
Becker, Harvey H.,	7,	Emaus.
Behal, Florence L.,	20,	Philadelphia.
Belsner, Edna E.,	19, 20,	Allentown.

Benfield, Mabel R.,	7,	Emaus.
Benfield, N. N.,	7,	Emaus.
Berger, Grace Katheryn,	7,	Lebanon.
Bishop, Sarah Emily,	17, 19,	Bethlehem.
Bitler, Mary S.,	20,	Lebanon.
Bolton, Mahlon Frank,	17,	Lebanon.
Borst, Beatrice H.,	20,	Philadelphia.
Bortelle, Pearl,	20,	Philadelphia.
Bortz, Bessie G.,	20,	Allentown.
Bower, Esther Weightman,	20,	Philadelphia.
Bowman, Emily Florence,	7,	Freemansburg.
Boyer, Emma I.,	20,	Philadelphia.
Boyken, Mrs. S. V.,	9,	Harrisburg.
Breeze, Mayflower,	20,	Philadelphia.
Briody, Catherine Beatrice,	7,	Bethlehem.
Brubaker, Mrs. Sara,	7,	Cleona.
Burnham, Florence,	19,	Bethlehem.
Chubbuck, Mary Almira,	13,	Allentown.
Cleaver, Helen M.,	20,	Philadelphia.
Crouse, Elizabeth W.,	7,	Lebanon.
Crouse, Magdalena A.,	20,	Philadelphia.
Crow, Mary M.,	17,	Bethlehem.
Culp, Charlotte Martz,	7,	Williamsport.
Damrich, Ethel M.,	20,	Allentown.
Darkes, Edward J.,	17,	Fredericksburg.
Davies, Jeanette I.,	7,	Myerstown.
Demmy, Maurice Clinton,	17,	Shaefferstown.
Dickerson, Mary T.,	20,	Philadelphia.
Dieruff, Louis Edgar,	3,	Allentown.
Doebler, Sarah Sybilla,	7,	Lebanon.
Drake, Esther L.,	20,	Philadelphia.
Eagen, Eleanora Madelin,	7,	Bethlehem.
Eisenhard, J. L.,	13,	Allentown.
Erb, Elsie Norma,	7,	Bethlehem.
Esvenshade, John Walter,	17,	Lebanon.
Evans, John N.,	7,	Annville.
Fairchild, Enola G.,	2,	Bethlehem.
Farber, Hobart Amory, B.A., (*Lehigh University*)	17,	Northampton.
Fegley, S. J.,	13,	Allentown.
Fenner, Margaret G.,	20,	Allentown.
Fichthorne, Grace V.,	20,	Philadelphia.

Fishel, S. G.,	7,	Bethlehem.
Fisher, Caroline Derr,	7,	Lebanon.
Fitzgerald Florence G.,	20,	Philadelphia.
Fitzgerald, Mary Alice,	20,	Philadelphia.
Folk, Hanna Elizabeth,	7,	Bethlehem.
Forbes, Elizabeth A.,	20,	Philadelphia.
Foreman, Anna Bard,	20,	Allentown.
Forstler, Florence J.,	20,	Allentown.
Forstler, Mae E.,	20,	Allentown.
Frankenfield, Ira Myers,	17,	Bethlehem.
Frankenfield, Mahlon L.,	13, 17,	Allentown.
Frable, Adam Quincy,	7,	Bethlehem.
Frederick, Mrs. Ida K.,	20,	Philadelphia.
Frey, Alma B.,	20,	Philadelphia.
Frick, L. G.,	20,	Allentown.
Friedman, Mary,	20,	Philadelphia.
Fritsch, J. W.,	20,	Allentown.
Fulmer, Sarah T.,	20,	Philadelphia.
Gabriel, Gertrude,	20,	Philadelphia.
Ganey, Nora Loretta,	7,	Bethlehem.
Garr, Florence E.,	19,	Bethlehem.
Garrett, Joyce E.,	7,	Lebanon.
Geidner, Dorothy M.,	20,	Allentown.
Gemmi, Lillian,	7,	Lebanon.
Giles, Lillian Belle,	7,	Bethlehem.
Gondell, Grace,	20,	Philadelphia.
Grubb, Percy Lamar, B.A., (*Lehigh University*)	9,	Harrisburg.
Gruber, Alice,	7,	Lebanon.
Grumbein, Dorothy Elizabeth,	17,	Lebanon.
Haag, James Harold,	7,	Lebanon.
Haehnle, Florence H.,	12,	Bethlehem.
Hall, Alice K.,	20,	Philadelphia.
Haller, Alma Good,	20,	Allentown.
Hanigan, Alice M.,	20,	Philadelphia.
Harbuch, Emily Octavia,	20,	Philadelphia.
Harting, H. E.,	14,	Emaus.
Hayes, Mrs. Jessie Vache,	20,	Philadelphia.
Hazlett, Helen Steel,	20,	Philadelphia.
Heffner, Mame C.,	20,	Allentown.
Helm, Sara Elizabeth,	7,	Lebanon.
Hemsath, Annie Elizabeth,	2,	Bethlehem.

Herbein, Mabel Schaeffer,	7,	Bethlehem.
Herbert, George William,	3,	Allentown.
Herbert, Mrs. Mary Elizabeth,	3,	Allentown.
Herman, Almira Havergal,	7,	Bethlehem.
Hintz, Edna C.,	20,	Philadelphia.
Hoere, Helena,	19,	Bethlehem.
Hohe, Ruth A.,	7,	Emaus.
Homan, Martha B.,	20,	Philadelphia.
Horman, Grace Powel,	20,	Philadelphia.
Horn, Helen Miriam,	3,	Allentown.
Hoskin, Florence A.,	20,	Philadelphia.
Huhn, Blanche A.,	19,	Bethlehem.
Humma, Elizabeth C.,	20,	Philadelphia.
Iobst, Annie M.,	7,	Emaus.
Iobst, Helen A.,	7,	Emaus.
James, Ida C.,	2,	Bethlehem.
Jeffers, Margaret T.,	20,	Philadelphia.
Kassing, Jessie L.,	2,	Bethlehem.
Keath, Georgette Catherine,	7,	Schaefferstown.
Keener, Myles Luther,	17,	Fredericksburg.
Keiser, Laura Findley,	20,	Allentown.
Kestner, Elizabeth A.,	20,	Philadelphia.
Kissinger, Florence M.,	20,	Philadelphia.
Kistler, Alfarato Polly,	20,	Allentown.
Kistler, Claude Franklin,	3,	Allentown.
Klick, Charlotte D.,	17,	Lebanon.
Klingaman, Minnie E.,	7,	Emaus.
Kline, Mary Elizabeth,	3,	Allentown.
Knauss, Edward E.,	9,	Harrisburg.
Knedler, Katherine,	2,	Bethlehem.
Kohler, Annie E.,	7,	Macungie.
Kohler, Edwin Philip,	7,	Emaus.
Kraemer, Olga,	20,	Philadelphia.
Kramer, A. Elizabeth,	20,	Philadelphia.
Kratzer, Emma M.,	7,	Emaus.
Kratzer, Mamie F.,	7,	Emaus.
Kreider, Ida,	7,	Lebanon.
Kreider, Martha,	7,	Lebanon.
Kressler, Raymond H., A.B., (*Muhlenberg College*)	13,	Allentown.
Kuhns, Mabel C.,	7,	Emaus.
Kulp, Myra Wolf,	7,	Lebanon.

Kunkel, Eva M.,	9,	Harrisburg.
Kunkel, Mrs. George B.,	9,	Harrisburg.
Kunstman, G. Lillian B.,	20,	Philadelphia.
Kutz, William Alvin,	7,	Emaus.
Lambert, Beulah Florine,	7,	Bethlehem.
Larkin, Flavia,	20,	Philadelphia.
Laubach, Pauline E.,	12, 13,	Bethlehem.
Laubach, Steward Lovine,	7, 10, 13,	Easton,
Laurence, Margaret Emma,	2,	Bethlehem.
Laurence, Helen Matilda,	7,	Bethlehem.
Lehman, Mary H.,	7,	Lebanon.
Lessig, Ardath M.,	20,	Allentown.
Leswing, Joseph,	9,	Harrisburg.
Light, Grace E.,	7,	Avon.
Light, Naomi R.,	7,	Lebanon.
Livingood, J. Anna,	7,	Emaus.
Loch, Nevin Tilghman,	3,	Allentown.
Loos, Leah,	7,	Myerstown.
Loosbach, Elizabeth,	13, 18,	Allentown.
Loose, Annie F.,	7,	Hamburg.
Lucey, Mary Ellen,	7,	Bethlehem.
Luckenbach, Martha O.,	12,	Bethlehem.
Lutz, Lottie I.,	20,	Philadelphia.
McClelland, Sadie S.,	20,	Philadelphia.
McConlogue, Nellie D.,	1,	Bethlehem.
McCullough, H. R.,	13,	Allentown.
Mackay, Martha,	20,	Philadelphia.
Markley, Ava W.,	20,	Philadelphia.
Marsh, Anna L.,	2,	Bethlehem.
Mayer, Marie C.,	20,	Philadelphia.
Meade, Lillian S.,	18,	Easton.
Megargee, M. Laura,	20,	Philadelphia.
Meikle, William D.,	9,	Harrisburg.
Mill, Ella,	19,	Bethlehem.
Miller, Amelia S.,	20,	Philadelphia.
Miller, Bertha M.,	20,	Allentown.
Miller, Elizabeth V.,	20,	Reading.
Miller, Julia,	20,	Reading.
Miller, Katherine E.,	13,	Easton.
Miller, Lizzie E.,	20,	Reading.
Miller, Virginia,	9,	Harrisburg.

Moore, Mary K.,	20,	Philadelphia.
Morris, Emma L.,	20,	Philadelphia.
Morris, Jennie P.,	20,	Philadelphia.
Morris, Julia E. S.,	20,	Allentown.
Moyer, Esther S.,	20,	Allentown.
Moyer, Herbert Baldwin,	17,	Bethlehem.
Murray, Marion Helen,	2,	Bethlehem.
Neff, Esther Katherine,	20,	Allentown.
Neimeyer, Lila E.,	7,	Emaus.
Neimeyer, Lydia Amanda,	7,	Emaus.
Neumoyer, Margie L.,	7,	Emaus.
Neumoyer, William B.,	7,	Emaus.
Nies, Viola R.,	20,	Philadelphia.
O'Connell, Anne,	9,	Harrisburg.
Overfield, Edwin J.,	2,	Bethlehem.
Orff, Rita,	20,	Philadelphia.
Parrott, Caryl Sherman,	20,	Philadelphia.
Paull, Flora R.,	20,	Philadelphia.
Pearson, Mrs. Mary,	9,	Harrisburg.
Pennbacker, Hannah,	20,	Allentown.
Phillips, Esther Rosemond,	7, 13,	Bethlehem.
Pohl, Elizabeth Shimer,	18,	Easton.
Post, Hazel D.,	2,	Bethlehem.
Pott, Minnie Edna,	7,	Lebanon.
Raub, Estella,	20,	Allentown.
Rausch, Mary D.,	20,	Allentown.
Rebstock, Elizabeth,	7,	Lebanon.
Reddig, Etta Elizabeth,	20,	Philadelphia.
Reedy, William Gerhart,	7,	Lebanon.
Rees, Lillie May,	7,	Lebanon.
Reidel, Etta,	7,	Lebanon.
Rhoads, Sarah G.,	20,	Philadelphia.
Rhodes, Carrie M.,	20,	Philadelphia.
Riegel, Rhoda N.,	7,	Lebanon.
Rogers, Sylvia,	9,	Harrisburg.
Romig, Helen E.,	12, 13,	Philadelphia.
Ross, Dora E.,	2, 19,	Bethlehem.
Ross, Gladys M.,	19,	Bethlehem.
Roth, Lillie Hannah,	20,	Allentown.
Ruffenach, Louis S.,	20,	Philadelphia.
Ruffner, Elenora S.,	20,	Philadelphia.

Ruloff, Maude J.,	20,	Allentown.
Rupp, Lucy M.,	20,	Allentown.
Ruth, Esther Y.,	20,	Allentown.
Ruth, Helen Y.,	20,	Allentown.
Ruth, Verna Mae,	7,	Bethlehem.
Salem, Helen A.,	9,	Harrisburg.
Sanders, Elizabeth L.,	7,	Lebanon.
Sauerbier, Helen W.,	20,	Reading.
Sauerbier, May M.,	20,	Reading.
Schmick, Florence A.,	7,	Emaus.
Schmick, Lila S.,	7,	Emaus.
Schmoyer, Albert Isadore,	3,	Allentown.
Schneck, Sarah,	20,	Allentown.
Schools, Katherine,	7,	Lebanon.
Schuler, Adeline L.,	7,	Emaus.
Scott, Sallie Agnes,	7,	Lebanon.
Seidel, Charles Franklin,	3,	Allentown.
Seltzer, Edna E.,	7,	Lebanon.
Sharadin, Pauline E.,	20,	Philadelphia.
Shields, Rose Irene,	7,	Bethlehem.
Shunk, Helen M.,	12,	Bethlehem.
Silberman, Caroline Theresa,	7,	Bethlehem.
Sloan, Florence Regina,	20,	Philadelphia.
Smith, Ella Minerva,	7,	Lebanon.
Smith, Ethel A.,	20,	Philadelphia.
Smith, Isabel,	2,	Bethlehem.
Smith, Maud,	7,	Lebanon.
Solt, Ada May,	2,	Bethlehem.
Spahn, Mrs. Emma H.,	20,	Philadelphia.
Spayd, Mary Elizabeth,	7,	Lebanon.
Stameto, Bertha B.,	18,	Easton.
Steinmiller, Frances D.,	2,	Bethlehem.
Stemmer, Florence,	20,	Philadelphia.
Sterner, Mrs. Emma Schuttler,	20,	Philadelphia.
Stevens, Althea D.,	17,	Bethlehem.
Stober, Nathaniel Palm,	7,	Schaeferstown.
Strauss, E. F.,	7,	Emaus.
Strickler, Mary Ellen,	7,	Lebanon.
Strohmeier, Adella,	19,	Easton.
Strohmeier, Clara,	19,	Bethlehem.
Stuart, Katherine E.,	20,	Allentown.

Stuber, Dora M.,	20,	Allentown.
Swartz, Bessie,	19,	Bethlehem.
Taylor, Wedell H.,	9,	Harrisburg.
Thomas, George Edward,	13,	Allentown.
Thomas, Helen Lyndall,	20,	Philadelphia.
Uhrich, Elizabeth Sarah,	7,	Myerstown.
Van Deusen, Mrs. Mary Elizabeth,	17,	Lebanon.
Van Horn, Mary A.,	20,	Philadelphia.
Vignola, Rosa Anna,	20,	Philadelphia.
Warden, Ida Elizabeth,	9,	Harrisburg.
Weaver, Nellie Robb,	7,	Lebanon.
Webb, Charlotte B.,	20,	Philadelphia.
Wehr, Mrs. Fleetie Ivina,	20,	Allentown.
Weidman, Elizabeth M.,	7,	Lebanon.
Weiler, Harry Dankel,	3,	Allentown.
Weirbach, Mahlon T., A.B., (*University of Michigan*)	13,	Allentown.
Weiss, Elizabeth Helen Elaine,	2, 7,	Bethlehem.
Werner, Katherine B.,	20,	Allentown.
Wetherold, Angelina A.,	20,	Allentown.
Wetherold, Mark Andrew, B.S., (*Muhlenberg College*)	3,	Allentown.
Wetherold, Ralph Vitilas, B.S., (*Muhlenberg College*)	3,	Allentown.
White, R. H.,	13, 18,	Hampton, N. J.
Williams, Jean,	2,	Bethlehem.
Williams, Louise I.,	13,	Allentown.
Winters, Sarah E.,	10, 13,	Allentown.
Yeager, Howard J.,	17,	Emaus.
Yellis, Harriet C.,	20,	Allentown.
Zeugner, Georgeanna N.,	20,	Philadelphia.
Ziegenfuss, Mabel Lovella,	7, 13,	Bethlehem.
Ziegenfuss, Warren Allen, B.S., (*Muhlenberg College*)	13,	Allentown.
Ziegler, Gertrude,	20,	Philadelphia.
Zuck, Eva R.,	20,	Easton.

SECOND TERM, 1921-1922

	COURSE	RESIDENCE
Arndt, Harold Wesby,	21,	Harrisburg.
Bankes, Sarah K.,	21,	Harrisburg.

Baskin, Caroline May,	21,	Harrisburg.
Bender, Anna Mae,	21,	Harrisburg.
Bentley, Edith,	22,	Camp Hill.
Billow, Milton Oscar,	22,	Harrisburg.
Bingham, Mary Jane,	21,	Harrisburg.
Burgoon, Sarah Edith,	21,	Harrisburg.
Carey, Lizette F.,	21,	Harrisburg.
Dum, Elizabeth Augusta,	22,	Harrisburg.
Ewing, Mrs. Clara P.,	22,	Harrisburg.
Fitzimons, Lillian,	21,	Harrisburg.
Fritchey, Geneva,	21,	Harrisburg.
Gamble, Kathryn T.,	21,	Harrisburg.
Garman, Laura E.,	22,	Harrisburg.
Griffith, Isabella G.,	22,	Harrisburg.
Hoffman, Gertrude M.,	22,	Harrisburg.
Hoffman, Ida,	21,	Harrisburg.
Holland, Maybelle Lee,	21,	Harrisburg.
Hoover, Ruth Minerva,	21,	Harrisburg.
Hursh, L. Minnie,	21,	Harrisburg.
Johnstone, Marie M.,	21,	Harrisburg.
Keiter, Annie R.,	22,	Harrisburg.
Kerlin, Frank R.,	22,	Harrisburg.
Koons, Catherine M.,	21,	Harrisburg.
Kreider, Minerva M.,	22,	Harrisburg.
Kurzenknabe, Susan M.,	22,	Harrisburg.
McGowan, Alice C.,	21,	Harrisburg.
Madden, Margaret E.,	22,	Harrisburg.
Mann, Mrs. Edna F.,	22,	Harrisburg.
March, Mabel Jeannette,	22,	Harrisburg.
Melville, Claudine,	21,	Harrisburg.
Melville, Marie,	21,	Harrisburg.
Minnig, Blanche L.,	21,	Harrisburg.
Myers, Carrie Estella,	22,	Harrisburg.
O'Connell, Anna,	21,	Harrisburg.
Pendergast, Mary,	22,	Harrisburg.
Peters, Eva,	22,	Harrisburg.
Porter, Edna E.,	21,	Mechanicsburg.
Richwine, George Herbert,	22,	Camp Hill.
Rynard, Mary E.,	21,	Harrisburg.
Sherk, Earl J.,	21,	Harrisburg.
Sherk, Esther,	21,	Harrisburg.

Sloat, Laura M.,	21,	Harrisburg.
Solem, Olaf P.,	22,	Harrisburg.
Sparrow, Caroline,	22,	Harrisburg.
Stoner, Anna Mary,	22,	Harrisburg.
Stutsman, Myra F.,	21,	Harrisburg.
Tack, Ruth E.,	21,	Harrisburg.
Thomas, Mary Book,	22,	Harrisburg.
Tothero, Harry Harding,	22,	Harrisburg.
Tyson, Lulu Clare,	21,	Steelton.
Weirich, Iva Carrie,	22,	Harrisburg.
Wood, Sarah E.,	22,	Harrisburg.
Wray, Frank Edwin,	22,	Harrisburg.
Zimmerman, Annie M.,	22,	Harrisburg.
Zudrell, Anna E.,	21,	Harrisburg.

SUMMARY OF STUDENTS BY CLASSES AND COURSES

	* Graduates	Seniors	Juniors	Sophomores	Freshmen	Specials	Totals
Arts & Science	31	7	25	46	49	6	164
Business Adm..	2	10	32	51	72	8	175
Civil Eng.....	1	26	36	26	33		122
Mech. Eng.....	1	28	32	46	56	1	164
Mining Eng....	3	20	29	33	29	4	118
Metallurgy.....	1	17	15	15	9	1	58
Electric. Eng...	6	14	40	36	52	1	149
Chemistry.....	6			1	2		9
Chem. Eng.....	3	38	23	31	40	2	137
Naval Eng.....		12	5	7	11	1	36
Totals.....	54	172	237	292	353	24	1132

*Graduate students are listed in the department in which they are taking their major subject.

Students in Evening School of Business Administration.. 62
Students in Extension Summer Session, 1921..... 46
Students in Extension Courses, First Term, 1921-22..... 301
Students in Extension Courses, Second Term, 1921-22..... 57

Total 466

GEOGRAPHICAL SUMMARY OF STUDENTS

Arkansas	1
California	3
Colorado	2
Connecticut	19
Delaware	8
District of Columbia	42
Florida	4
Georgia	2
Illinois	6
Indiana	1
Iowa	1
Kentucky	1
Louisiana	1
Maryland	39
Massachusetts	14
Michigan	6
Missouri	1
New Jersey	177
New York	99
North Carolina	4
Ohio	18
Oklahoma	1
Pennsylvania	622
Rhode Island	4
South Carolina	2
Tennessee	2
Texas	1
Utah	2
Vermont	2
Virginia	8
Washington	1
West Virginia	8
Wisconsin	2
Wyoming	1
Argentine Republic	2
Azores	1
Brazil	1
Chile	1
China	9

Colombia	3
Cuba	2
Greece	2
Japan	1
Mexico	3
Venezuela	2
	1132

Administrative Officers, 15
Admission of Students, 18, 30
  Requirements, 18-20
Advanced Standing, Admission to, 29
Almanac, 2
Alumni Association, 170
Alumni Prizes, 171
  Award in 1921, 162
Alumni Prizes for Oratory, 171
Arboretum, 159
Arts and Science Club, 160
Arts and Science, College of
  Description, 32
  Requirements for admission, 18
  Schedules of studies, 34-37
  Undergraduate courses, 76
Assistant Professors, 10
Associate Professors, 8
Astronomy
  Graduate courses, 134
  Observatory, 155
  Undergraduate courses, 91
Athletic Field, 158
Biology
  Graduate courses, 139
  Undergraduate courses, 106
Buildings, 145
Business Administration, College of
  Description, 40
  Evening School, 130
  Requirements for admission, 19
  Schedule of studies, 42
  Undergraduate courses, 78
Calendar, 3
Callender Fellowship, 168
Carson Prize, 169
  Award in 1921, 162
Certificates, 30
Chandler Chemical Laboratory, 146
Chandler Chemistry Prizes, 169
  Award in 1921, 163
Chemical Engineering, Course in
  Description, 68
  Requirements for admission, 20
  Schedule of studies, 72
Chemistry, Course in
  Description, 65
  Graduate courses, 141
  Requirements for admission, 20
  Schedule of studies, 67
  Undergraduate courses, 116
Christmas Hall, 154
Civil Engineering, Course in
  Description, 43
  Graduate courses, 142
  Requirements for admission, 20.
  Schedule of studies, 46
  Undergraduate courses, 92
College Commons, 157
Conference Department, 15, 125
Coppee Hall, 154
Coxe Memorial Fund, 168
Coxe Memorial Library, 156
Coxe Mining Laboratory, 152
Departmental Societies, 162
Dormitories, 156
Drown Memorial Hall, 157
Economics
  Graduate courses, 135
  Undergraduate courses, 78
Economic Geography, 81
Education
  Graduate courses, 139
  Undergraduate courses, 77
Electrical Engineering, Course in
  Description, 60
  Graduate courses, 136
  Requirements for admission, 20
  Schedule of studies, 64
  Undergraduate courses, 112
Electrical Engineering Prize, 169
Engineering Societies, 160
English
  Graduate courses, 135
  Undergraduate courses, 89
Examination, Entrance, 29
  Examinations at schools, 31
Expenses, 144
Extension Courses, 125
Faculty, 6
  Committees, 16
Forestry, 106
Founder's Day, 161
Frazier and Ringer Memorial Fund, 174
Fritz Engineering Laboratory, 152
French
  Graduate courses, 140
  Undergraduate courses, 87
Geology
  Graduate courses, 138
  Undergraduate courses, 103
German
  Graduate courses, 138
  Undergraduate courses, 85
Graduate Courses
  Admission to, 30, 133
  List, 134
Greek
  Graduate courses, 136
  Undergraduate courses, 84
Gymnasium
  Description, 157
  Physical education, 123
Haines Scholarship, 167
History
  Graduate courses, 135
  Undergraduate courses, 82
Honor List, 1921, 163
Honor System, 161
Honorary Scholarship Societies, 159
Instructors, 12
Italian
  Graduate courses, 141
  Undergraduate courses, 89

Latin
Graduate courses, 143
Undergraduate courses, 83
Lecturers, 9
Lectures, 159
Library
University Library, 155
Officers of, 16
Coxe Memorial Library, 156
List of Studies
Graduate courses, 134
Undergraduate courses, 76
Mathematics
Graduate courses, 134
Undergraduate courses, 91
Mechanical Engineering, Course in
Description, 47
Requirements for admission, 20
Schedule of studies, 50
Undergraduate courses, 96
Mercur Scholarships, 167
Metallurgy, Course in
Description, 51
Graduate courses, 143
Requirements for admission, 20.
Schedule of studies, 54
Undergraduate courses, 100
Military Science and Tactics, 122
Mining Engineering, Course in
Description, 55
Graduate courses, 137
Requirements for admission, 20
Schedule of studies, 59
Undergraduate courses, 108
Museums, 159
Observatory, 155
Packer Hall, 145
Packer Memorial Church, 16
Description, 155
Services, 161
Philosophy
Graduate courses, 139
Undergraduate courses, 76
Physical Education, 123
Physics
Graduate courses, 141
Undergraduate courses, 110
Physics Laboratory, 147
Political Science, 81
Portuguese, 88
Pre-Medical Courses, 36-37
Price Hall, 156
Price Prize, 169
Award in 1921, 162
Prickitt Scholarship, 168
Prizes
Alumni Prizes, 171
Carson Prize, 169
Chandler Prizes, 169
Electrical Engineering Prize, 169
Price Prize, 169
Wilbur Prizes, 169
Williams Prizes, 172
Professors, 6
Psychology
Graduate courses, 139
Undergraduate courses, 76
Romance Languages, 87
Saucon Hall, 154
Sayre Observatory, 155
Sayre Park, 158
Scholarships
Coxe Memorial Fund, 168
Haines Scholarship, 167
Mercur Scholarship, 167
Prickitt Scholarship, 168
Wilbur Scholarship, 167
Williams Fund, 168
Ship Construction and Marine Transportation, Course in
Description, 73
Graduate courses, 143
Requirements for admission, 20
Schedule of studies, 75
Undergraduate courses, 120
Site of the University, 145
Spanish
Graduate courses, 141
Undergraduate courses, 88
Students, List of, for 1921-1922, 175
Graduate Students, 175
Seniors, 178
Juniors, 182
Sophomores, 188
Freshmen, 196
Special Students, 205
Extension Course Students, 207
Summary of Students:
By Classes and Courses, 219
By Geographical representation, 220
Studies, List of, 76
Summer Term, 132
Taylor Field, 158
Taylor Gymnasium, 157
Taylor Hall, 156
Teachers' Courses, 38
Theses, 161
Trustees, 4
Committees, 5
Honorary Alumni Trustees, 4.
Officers of the Board, 5.
Tuition, 144
Undergraduate Courses, 76
University Day, 161
University Sunday, 161
Wilbur Engineering Laboratory, 149
Wilbur Prizes, 169
Award in 1921, 162
Wilbur Scholarship, 167
Award in 1921, 162
Williams Fund, 168
Williams Hall, 150
Williams Prizes, 172
Y. M. C. A., 160

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BETHLEHEM
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1922

JULY

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1923

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CALENDAR

1922	1922—1923
Sept. 15, 16, 18, 19, (Friday, Saturday, Monday, Tuesday)	Examinations for admission.
Sept. 20, 3.30 P.M., (Wednesday)	First term begins.
Oct. 7, (Saturday)	Founder's Day.
Nov. 29, 4.00 P.M., (Wednesday)	Thanksgiving holidays begin.
Dec. 4, 7.45 A.M., (Monday)	Thanksgiving holidays end.
Dec. 20, 4.00 P.M., (Wednesday)	Christmas holidays begin.
1923	
Jan. 4, 7.45 A.M., (Thursday)	Christmas holidays end.
Jan. 29, 8.00 A.M., (Monday)	Examinations begin.
Feb. 3, 5.00 P.M., (Saturday)	Examinations end.
Feb. 8, 7.45 A.M., (Thursday)	Second term begins.
Feb. 22, (Thursday, Washington's Birthday)	Junior Oratorical Contest.
March 28, 4.00 P.M., (Wednesday)	Easter holidays begin.
April 2, 7.45 A.M., (Monday)	Easter holidays end.
May 28, 8.00 A.M., (Monday)	Senior examinations begin.
May 30, 8.00 A.M., (Wednesday)	Other examinations begin.
June 6, 5.00 P.M., (Wednesday)	Examinations end.
June 9, (Saturday)	Alumni Day.
June 10, (Sunday)	Baccalaureate Sunday.
June 11, (Monday)	Class Day.
June 12, (Tuesday)	University Day.
June 13, (Wednesday)	Summer term begins.
June 13, 14, 15, 16, (Wednesday, Thursday, Friday, Saturday)	Examinations for admission.

1923	1923—1924
Sept. 14, 15, 17, 18, (Friday, Saturday, Monday, Tuesday)	Examinations for admission.
Sept. 19, 3.30 P.M., (Wednesday)	First term begins.
Oct. 6, (Saturday)	Founder's Day.
Nov. 28, 4.00 P.M., (Wednesday)	Thanksgiving holidays begin.
Dec. 3, 7.45 A.M., (Monday)	Thanksgiving holidays end.
Dec. 19, 4.00 P.M., (Wednesday)	Christmas holidays begin.
1924	
Jan. 3, 7.45 A.M., (Thursday)	Christmas holidays end.
Jan. 28, 8.00 A.M., (Monday)	Examinations begin.
Feb. 2, 5.00 P.M., (Saturday)	Examinations end.
Feb. 7, 7.45 A.M., (Thursday)	Second term begins.
Feb. 22, (Friday, Washington's Birthday)	Junior Oratorical Contest.
April 16, 4.00 P.M., (Wednesday)	Easter holidays begin.
April 21, 7.45 A.M., (Monday)	Easter holidays end.
May 26, 8.00 A.M., (Monday)	Senior examinations begin.
May 28, 8.00 A.M., (Wednesday)	Other examinations begin.
June 4, 5.00 P.M., (Wednesday)	Examinations end.
June 7, (Saturday)	Alumni Day.
June 8, (Sunday)	Baccalaureate Sunday.
June 9, (Monday)	Class Day.
June 10, (Tuesday)	University Day.
June 11, (Wednesday)	Summer term begins.
June 11, 12, 13, 14, (Wednesday, Thursday, Friday, Saturday)	Examinations for admission.

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LEHIGH UNIVERSITY

Lehigh University was chartered by the Legislature of Pennsylvania by act dated February 9, 1866. In 1865 the Hon. Asa Packer, of Mauch Chunk, inaugurated a movement to provide an institution that would afford training and education in the learned professions as then recognized, and in technical branches, the importance of which was then just becoming apparent in the development of the industrial and transportation interests of the country. He made an initial donation of $500,000 and of a large tract of land for this purpose, to which he added largely during his lifetime and by his will.

Since its foundation the equipment and resources of the University have steadily increased due to the continued interest of the University's trustees, alumni and friends. The present endowment totals $3,000,000. The first important addition to the University's original plant was the Sayre Observatory, donated in 1869 by Robert H. Sayre, of Bethlehem. Later donations include Packer Memorial Church, 1887; Williams Hall, 1902; Drown Memorial Hall, 1907; the University Commons, 1907; the Wilbur Heating Plant and Engineering Laboratory, 1907; Taylor Hall, 1907; Sayre Park, 1909; Coxe Mining Laboratory, 1910; Fritz Engineering Laboratory, 1910; Taylor Gymnasium and Taylor Field, 1913.

Lehigh University offers the following courses:

COLLEGE OF ARTS AND SCIENCE:

1. The Course in Arts and Science.

COLLEGE OF BUSINESS ADMINISTRATION:

1. The Course in Business Administration.

COLLEGE OF ENGINEERING:

1. The Course in Civil Engineering.
2. The Course in Mechanical Engineering.
3. The Course in Metallurgy.
4. The Course in Mining Engineering.
5. The Course in Electrical Engineering.
6. The Course in Chemistry.
7. The Course in Chemical Engineering.
8. The Course in Ship Construction and Marine Transportation.

Courses are described in detail on pages 32 to 76.

REQUIREMENTS FOR ADMISSION

Candidates for admission to Lehigh University must be at least sixteen years of age, must present testimonials of good moral character, and must be qualified in fifteen entrance units as enumerated below.

THE COLLEGE OF ARTS AND SCIENCE

Candidates for admission to the College of Arts and Science must present the following subjects:

	Units
English,	3
History,	1
Elementary Algebra, A and B,	1½
Plane Geometry,	1
Latin A and B or German A or French A or Spanish A,	2
Elective Subjects,	6½
	15

THE COLLEGE OF BUSINESS ADMINISTRATION

Candidates for admission to the College of Business Administration must present the following subjects:

	Units
English,	3
History,	1
Elementary Algebra, A and B,	1½
Plane Geometry,	1
German A or French A or Spanish A or Latin A and B,	2
Elective Subjects,	6½
	15

THE COLLEGE OF ENGINEERING

Candidates for admission to the College of Engineering must present the following subjects:

	Units
English,	3
History,	1
Elementary Algebra, A and B,	1½
Plane Geometry,	1
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
German A or French A or Spanish A,	2
Elective Subjects,	5½
	15

* A unit represents a year's study in any subject in a secondary school, constituting approximately a quarter of a full year's work. A four-year secondary school curriculum should be regarded as representing not more than sixteen units of work.

ELECTIVE SUBJECTS

	Units
Advanced Algebra,	½
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
Greek,	1, 2 or 3
Latin,	1, 2, 3 or 4
French,	1, 2 or 3
German,	1, 2 or 3
Spanish,	1, 2 or 3
American History,	1
Ancient History,	½ or 1
Modern History,	1
English History,	½ or 1
Civics,	½, 1 or 1½
Economics,	½ or 1
General Science,	1
Physics	1
Chemistry,	1
Biology,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Manual Training,	½ or 1
Freehand Drawing,	½
Mechanical Drawing,	½
Industrial History,	½ or 1
Commercial Geography,	½ or 1
Bookkeeping, Stenography and Typewriting,	1 or 2

Other subjects from the curriculum of a high school of the first class may be credited up to a total of one unit.

Detailed information concerning these subjects is given on pages 23 to 31.

DATES OF EXAMINATIONS

Examinations for admission to the University are held in June and September in the following order:

First Day.—Geometry, 8 A.M.; Physics, Ancient History, 2 P.M.

Second Day.—Elementary Algebra, *A*, 8 A.M. to 10 A.M., Elementary Algebra, *B*, 10 A.M. to 12 M.; Trigonometry, 2 P.M.

Third Day.—Latin, 8 A.M.; German, French, Spanish, Greek, 2 P.M.

Fourth Day.—English, 8:30 A.M.; History, 2 P.M.

The dates for 1923 and 1924 are as follows: in 1923, Wednesday, Thursday, Friday and Saturday, June 13, 14, 15 and 16; and Friday, Saturday, Monday and Tuesday, September 14, 15, 17 and 18; in 1924, June 11, 12, 13 and 14, and September 12, 13, 15 and 16.

Examinations in subjects presented for elective units may be arranged for by correspondence with the Registrar.

Candidates for admission wishing to take examinations in any advanced subject for credit should notify the Registrar before September 1.

Certificates of the College Entrance Examination Board are accepted instead of the entrance examinations held at the University in those subjects in which the recorded grade is 60 per cent. or over.

ADMISSION TO ADVANCED STANDING

A candidate for admission to advanced standing in any course must meet the entrance requirements and in addition pass examinations in the work already done by the class which he desires to enter. These examinations are held in September, in the week preceding the opening of the University.

A student from another college or university is admitted without entrance examinations, provided he presents satisfactory credentials that he has covered the entrance subjects required at this University and has attended another college or university for one or more complete terms, evidence of which should be filed with the Registrar. If a student has been dropped from another college or university, he must present his record to the Committee on Standing of Students and terms of admission will be fixed.

Applicants who have obtained a certificate that the entrance requirements of the University are satisfied are advised to report personally to the Secretary of the Faculty. The Secretary of the Faculty will issue to the applicant a paper authorizing him to confer with the professors regarding the subjects for which he desires credit. It is necessary for an applicant to bring a certificate naming the subjects completed at another college, together with a copy of the catalogue or register of the college; and it is desirable for him to bring his drawings, field notes, computations and laboratory notebooks for inspection, and personal certificates from his teachers showing the grades attained at the college from which he comes. Professors may admit the student to advanced studies if satisfied with these evidences of proficiency, or they may require formal examinations in the subjects for which he desires credits.

Graduates of other colleges having the Bachelor's degree or its equivalent are similarly admitted to engineering courses.

The length of time for the completion of a course will depend upon the student's attainments at entrance and his ability. Every opportunity is given for the completion of a course in minimum time.

A student who anticipates taking a technical course at Lehigh University after graduation from college should so arrange his work in college as to cover as many as possible of the subjects of the Freshman and Sophomore years of the technical course he intends to enter.

ADMISSION TO GRADUATE COURSES

Graduates of Lehigh University and others having satisfactory degrees conferred elsewhere may be admitted to advanced studies as outlined on page 137.

SCHOOL CERTIFICATES

Lehigh University has no permanent arrangement with any school whereby certificates are accepted instead of entrance examinations.

Applicants for admission on certificate should request their school principals to send to the Registrar as soon as the school closes in June a complete record of their work. Blanks for this purpose are supplied by the University.

Certificates are accepted in subjects in which records are satisfactory to the professors concerned and in which the work has been completed within reasonable time limits.

For admission to the College of Engineering records in mathematical subjects will not be accepted unless there is evidence of some satisfactory school study of mathematics completed not earlier than January of the entrance year.

For admission to the College of Arts and Science and to the College of Business Administration records in mathematical subjects will not be accepted unless there is evidence of some satisfactory school study of mathematics completed not earlier than June of the year preceding the entrance year.

For admission to the College of Engineering, to the College of Arts and Science and to the College of Business Administration records in the required foreign language will not be accepted unless there is evidence of some satisfactory school study of the language completed not earlier than January of the year preceding the entrance year.

EXAMINATIONS AT SCHOOLS

Upon the request of school principals the June entrance examinations may be held at schools on the regularly scheduled dates. Requests for examination papers should be sent to the Registrar before June 1.

The detailed requirements in the various subjects are as follows:

ENGLISH

Preparation in English has three main objects: (a) command of correct and clear English, spoken and written; (b) ability to use the vernacular with accuracy and appreciation; and (c) some acquaintance with the simpler English classics.

ENGLISH GRAMMAR AND COMPOSITION. The first two objects require instruction in grammar and composition. English grammar should be reviewed in the secondary school; and correct spelling and grammatical accuracy should be rigorously exacted in connection with all written work during the four years. The principles of English composition governing punctuation, the use of words, paragraphs, and the different kinds of composition, including letter writing, should be thoroughly mastered; and practice in composition, oral as well as written, should extend throughout the secondary school period. Written exercises may well comprise narration, description, and easy exposition based upon the principles of elementary rhetoric, as given in any approved high school rhetoric. It is advisable that subjects for this work be taken from the student's personal experience, general knowledge, and studies other than English, as well as from his reading in literature. Finally, special instruction in language and composition should be supported by concerted efforts of teachers in all branches to cultivate in the student the habit of using good English in his recitations and various exercises, whether oral or written, making every recitation in some degree an exercise in English.

LITERATURE. The third object is sought by means of two lists of books, headed respectively reading and study; from which may be framed a progressive course in literature cover-

ing four years. In connection with both lists, the student should be trained in reading aloud and be encouraged to commit to memory some of the more notable passages both in verse and in prose. The books for reading and study are to be selected from the groups suggested by the Conference on Uniform Entrance Requirements in English. 3 units.

HISTORY

The requirement in History is based on the recommendation of the Committee of Seven of the American Historical Association.

ANCIENT HISTORY, with special reference to Greek and Roman History, and including also a short introductory study of the more ancient nations and the chief events of the early Middle Ages, down to the death of Charlemagne (814). 1 unit.

MEDIAEVAL AND MODERN EUROPEAN HISTORY, from the death of Charlemagne to the present time. 1 unit.

ENGLISH HISTORY, with due reference to social and political development. 1 unit.

AMERICAN HISTORY AND CIVIL GOVERNMENT, with due reference to social and political development. 1 unit.

The examination in history will be so framed as to require comparison and the use of judgment on the pupil's part rather than the mere use of memory. The examinations will presuppose the use of good text-books, collateral reading, and practice in written work. Geographical knowledge will be tested by requiring the location of places and movements on an outline map.

MATHEMATICS

ELEMENTARY ALGEBRA, A (ALGEBRA TO QUADRATICS). The four fundamental operations for rational algebraic expressions. Factoring, determination of highest common factor and lowest common multiple by factoring. Fractions, including complex fractions, and ratio and proportion. Linear equations, both numerical and literal, containing one or more unknown quantities. Problems depending on linear equations. Radicals, including the extraction of the square root of polynomials and of numbers. Exponents, including the fractional and negative. 1 unit.

ELEMENTARY ALGEBRA, B (QUADRATICS AND BEYOND). Quadratic equations, both numerical and literal. Simple cases of equations with one or more unknown quantities, that can be solved by the methods of linear or quadratic equations. Problems depending on quadratic equations. The binomial theorem for positive integral exponents. The formulas for the *n*th term and the sum of the terms of arithmetic and geometric progressions with applications. ½ unit.

ADVANCED ALGEBRA. Permutations and combinations, limited to simple cases. Complex numbers, with graphical representation of sums and differences. Determinants, chiefly of the second, third, and fourth orders, including the use of minors and the solution of linear equations. Numerical equations of higher degree, and so much of the theory of equations, with graphical methods, as is necessary for their treatment, including Descarte's rule of sign and Horner's method, but not Sturm's functions or multiple roots. ½ unit.

PLANE GEOMETRY. The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas; regular polygons and the measurements of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of line and plane surfaces. 1 unit.

SOLID GEOMETRY. The usual theorems and constructions of good text-books, including the relations of planes and lines in space; the properties and measurements of prisms, pyramids, cylinders and cones; the sphere and the spherical triangle. The solution of numerous original exercises, including loci problems. Application to the mensuration of surfaces and solids. ½ unit.

PLANE TRIGONOMETRY. Definitions and relations of the six trigonometric functions as ratios; circular measurement of angles. Proofs of principal formulas, in particular for the sine, cosine, and tangent of the sum and the difference of two angles, of the double angle and the half angle, the product expressions for the sum or the difference of two sines or of two cosines, etc.; the transformation of trigonometric expressions

by means of these formulas. Solution of trigonometric equations of a simple character. Theory and use of logarithms (without the introduction of work involving infinite series). The solution of right and oblique triangles and practical applications. Candidates must bring their logarithmic tables to the examination. ½ unit.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of the metric system.

PHYSICS

The course of instruction in Physics should include:

(a) The study of some standard text-book, for the purpose of obtaining a connected view of the subject; (b) instruction by lecture table demonstrations, to be used mainly for illustration of the facts and phenomena of physics; (c) individual laboratory work consisting of at least thirty experiments.

The aim of laboratory work should be to supplement the pupil's fund of concrete knowledge and to cultivate his power of accurate observation and clearness of thought and expression. The exercises should be chosen with a view to furnishing forceful illustrations of fundamental principles and their practical applications. They should be such as to yield results capable of ready interpretation, obviously in conformity with theory, and free from the disguise of unintelligible units.

1 unit.

GERMAN

Elemenary German, A. This requirement follows, in the main, the recommendation of the Committee of Twelve of the Modern Language Association. It is expected that two whole years will be given to the work.

During the first year the work should comprise: (1) Careful drill in pronunciation. (2) The memorizing and frequent repetition of easy colloquial sentences. (3) Drill upon the rudiments of grammar, that is, upon the inflection of the articles, of such nouns as belong to the language of every-day life, of adjectives, pronouns, weak verbs and the more usual strong verbs; also upon the use of the more common prepositions, the simpler uses of the modal auxiliaries and the ele-

mentary rules of syntax and word-order. (4) Abundant easy exercises, designed not only to fix in mind the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression. (5) Reading of from 75 to 100 pages of graduated texts from a reader, with constant practice in translating into German easy variations upon sentences selected from the reading lesson (the teacher giving the English), and in the reproduction from memory of sentences previously read.

During the second year the work should comprise: (1) The reading of from 150 to 200 pages of literature in the form of easy stories and plays. (2) Accompanying practice, as before, in the translation into German of easy variations upon the matter read and in the off-hand reproduction, sometimes orally and sometimes in writing, of the substance of short and easy selected passages. (3) Continued drill in the rudiments of the grammar, directed to the ends of enabling the pupil, first, to use his knowledge with facility in the formation of sentences, and secondly, to state his knowledge correctly in the technical language of grammar. 2 units.

Intermediate German, B. This work should comprise, in addition to the elementary course, the reading of about 400 pages of moderately difficult prose and poetry, with constant practice in giving, sometimes orally and sometimes in writing, paraphrases, abstracts, or reproductions from memory of selected portions of the matter read; also grammatical drill upon the less usual strong verbs, the use of articles, cases, auxiliaries of all kinds, tenses and modes (with special reference to the infinitive and the subjunctive), and likewise upon word order and word formation. 1 unit.

FRENCH

Elementary French, A. This requirement follows, in the main, the recommendation of the Committee of Twelve of the Modern Language Association. It is expected that two whole years will be given to the work.

During the first year the work should comprise: (1) Careful drill in pronunciation. (2) The rudiments of grammar, including the inflection of the regular and the more common irregular verbs, the plural of nouns, the inflection of adjectives,

participles and pronouns; the use of personal pronouns, common adverbs, prepositions and conjunctions; the order of words in the sentence and the elementary rules of syntax. (3) Abundant easy exercises, designed not only to fix in the memory the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression. (4) The reading of from 100 to 175 pages of graduated texts, with constant practice in translating into French easy variations of the sentences read (the teacher giving the English), and in reproducing from memory sentences previously read. (5) Writing French from dictation.

During the second year the work should comprise: (1) The reading of from 250 to 400 pages of easy modern prose in the form of stories, plays or historical or biographical sketches. (2) Constant practice, as in the previous year, in translating into French easy variations upon the texts read. (3) Frequent abstracts, sometimes oral and sometimes written, of portions of the text already read. (4) Writing French from dictation. (5) Continued drill upon the rudiments of grammar, with constant application in the construction of sentences. (6) Mastery of the forms and uses of pronouns, pronominal adjectives, of all but the rare irregular verb forms, and of the simpler uses of the conditional and subjunctive. 2 units.

Intermediate French, B. This should comprise the reading of from 400 to 600 pages of French, of ordinary difficulty, a portion to be in the dramatic form; constant practice in giving French paraphrases, abstracts or reproductions from memory of selected portions of the matter read; the study of a grammar of moderate completeness; writing from dictation. 1 unit.

SPANISH

Elementary Spanish, A. Two years' preparation, covering the following ground:

During the first year: (1) Drill in correct production of Spanish sounds. (2) The rudiments of grammar, illustrated by abundant easy exercises. (3) The reading of about 150 pages of graduated texts with constant translating into Spanish of easy variations of sentences read, the teacher giving the English. (4) Aural Drill. Practice in translating into English

of Spanish words, clauses and sentences heard but not seen, the teacher giving the Spanish.

During the second year: (1) Reading of 250 to 400 pages of easy modern prose. (2) Constant practice in translating into Spanish easy variations upon the texts read. (3) Aural practice and drill in pronunciation. (4) Mastery of the form and uses of pronouns, of the subjunctive mode and of the forms of the radical changing verbs. 2 units.

INTERMEDIATE SPANISH, B. The reading of not less than 500 additional pages of Spanish prose together with the translation of at least 40 pages of simple connected English prose into Spanish. 1 unit.

LATIN

The following requirements in Latin are in accordance with the recommendation made by the American Philological Association, October, 1909.

LATIN, A and B. First and Second Year Latin. Grammar, Elementary Prose Composition. Reading of an amount not less than Cæsar, *Gallic War*, I-IV, selected by the schools from Cæsar (*Gallic War* and *Civil War*) and Nepos (*Lives*). 2 units.

LATIN, C. Third Year Latin. Reading of an amount not less than Cicero, *Orations against Catiline*, *For the Manilian Law*, and *For Archias*, selected by the schools from Cicero (*Orations*, *Letters* and *De Senectute*) and Sallust (*Catiline* and *Jugurthine War*). 1 unit.

LATIN, D. Fourth Year Latin. Reading of an amount not less than Vergil, *Aeneid*, I-VI, selecetd by the schools from Vergil (*Aeneid*, *Bucolics*, and *Georgics*) and Ovid (*Metamorphoses*, *Fasti*, *Tristia*, *Amores*). 1 unit.

GREEK

GREEK. Grammar; Elementary Prose Composition, consisting principally of detached sentences to test the candidate's knowledge of grammatical construction; Xenophon: the first four books of the *Anabasis;* the translation, at sight, of a passage from some work of Xenophon. 2 units.

GREEK. Homer's *Iliad*, I-III: The first three books of the *Iliad* (omitting II, 494-end), and the Homeric forms, constructions, and prosody. 1 unit.

CHEMISTRY

The requirement in Chemistry is based on the report of the Committee on Chemistry of the Science Department of the National Educational Association.

ELEMENTARY CHEMISTRY. It is recommended that the candidate's preparation in chemistry include: (a) individual laboratory work, comprising at least forty exercises; (b) instruction by lecture table demonstrations, to be used mainly as a basis for questioning upon the general principles involved in the pupil's laboratory investigations; (c) the study of at least one standard text-book, to the end that the pupil may gain a comprehensive and connected view of the most important facts and laws of elementary chemistry. 1 unit.

Students, properly qualified, will be examined in Elementary Chemistry on the first Saturday of the term; those passing the examination will be privileged to omit Elementary Chemistry (390) and will, instead, take Chemistry (393) and Chemical Laboratory (393a) during the first term.

DRAWING

FREEHAND DRAWING. Sketching of simple geometrical figures, of objects, and from copy. At least twenty plates must be submitted. ½ unit.

MECHANICAL DRAWING. The use of instruments and the preparation of at least twenty plates, illustrating the elements of descriptive geometry or simple machine parts. ½ unit.

PHYSIOGRAPHY

PHYSIOGRAPHY. The study of a standard text-book in physical geography, that a knowledge may be gained of the essential principles, and of well-selected facts illustrating those principles. Individual laboratory work, comprising at least forty exercises with notebook, is recommended. ½ or 1 unit.

BOTANY

BOTANY. An amount equal to that contained in Bergen's *Foundations of Botany* with laboratory work. ½ or 1 unit.

PHYSIOLOGY AND HYGIENE

PHYSIOLOGY AND HYGIENE. A course covering approximately what is given in such a text-book as Huxley & Youman's *Physiology and Hygiene.* ½ or 1 unit.

ZOOLOGY

ZOÖLOGY. The equivalent of Jordan, Kellogg & Heath's *Animal Studies* with laboratory work. ½ or 1 unit.

MANUAL TRAINING

MANUAL TRAINING. Shop work in wood or metal in schools giving courses in manual training. ½ or 1 unit.

BOOKKEEPING, TYPEWRITING AND STENOGRAPHY

BOOKKEEPING, TYPEWRITING AND STENOGRAPHY, covering a formal course of study at school. 1 or 2 units.

THE COLLEGE OF ARTS AND SCIENCE

The College of Arts and Science of Lehigh University represents the traditional college course, modified to meet the needs of modern life and thought. Such a course is, in its purpose, primarily informing and cultural, not vocational; it seeks to gratify intellectual curiosity, to cultivate a love of learning, to impart the knowledge and discipline which are essential to intelligent and forceful living. It has besides certain specific uses: it is the customary approach to the professions of medicine, law, theology and teaching, and the usual basis for graduate study for higher degrees.

The entrance requirements are liberal, and such as may be met readily by graduates of Pennsylvania high schools of the first class. A statement of them may be found on page 19.

The plan of study comprises required subjects and unassigned or elective subjects. The required and elective subjects occupy respectively about two-thirds and one-third of the course. The required studies embrace courses in the English, German and French languages and literatures (two years each), mathematics (trigonometry and solid geometry), chemistry (elementary chemistry and qualitative analysis), economics, history, psychology, biology, geology, and philosophy, subjects which may be regarded as fundamental to the nature and purpose of the course.

The studies of the Freshman year follow in general the subjects which have been presented for entrance. After the Freshman year the course becomes increasingly elective, a minimum of three hours weekly of electives being allowed in the Sophomore year, six in the Junior year and ten in the Senior year. An appointed member of the Faculty counsels students in the choice of their studies and keeps before them the importance of selecting their work according to a definite and constructive plan. Students are dealt with individually rather than in groups, and the effort is made to suit the studies of each to his qualifications and purpose.

The minimum course of study comprises fifteen scholastic hours or periods weekly. Work is assigned on the assumption that two hours are required by the average student to prepare

adequately for a recitation. Students of proved ability, however, are not limited to this minimum after the Freshman year, and even in that year an entering student may increase his course in chemistry from three to four hours, if, as in the case of those who are preparing for the study of medicine, there is good reason. In general, the College aims at a reasonable amount of work well done, rather than a large amount indifferently done.

Instruction is given by lectures, by recitations, by the assignments of readings and topics for study and dissertations, and, when the subject admits of it, by practical work in field or laboratory. Field work or laboratory work accompanies courses in geology, physics, chemistry, biology, psychology, and allied subjects; students in advanced mathematics use, in their study of astronomy, the telescope and other instruments of the Sayre Observatory. Practice in teaching is provided in the schools of the vicinity for those who expect to follow teaching. Students residing in Leonard Hall who are preparing, under the direction of the Bishop of the Episcopal Diocese of Bethlehem, for the theological seminary have opportunity for practical religious work.

In the following plan of study the unassigned hours are filled by subjects selected from the listed elective studies. These are not necessarily confined to the year to which in the lists they are assigned, but may be taken earlier or subsequently. But this privilege is limited by considerations of the roster and the principle that the course of each student shall be systematic and not haphazard.

Students who enter with full entrance requirements in Latin and Greek (four and three units) will continue these studies during the Freshman year. A class in Beginners' Greek, open to Freshmen and Sophomores, is formed in alternate years. Students who begin Greek in College will ordinarily pursue the study of Greek for three years.

The degree of Bachelor of Arts (B.A.) is conferred upon graduates of the College of Arts and Science.

THE COURSE IN ARTS AND SCIENCE

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
English	120, 121	(3)	3	6	9	English	122, 125	(3)	3	6	9
Plane Trig.	141	(3)	3	6	9	Solid Geom.	140	(3)	3	6	9
German or French	77 or 70 / 98	(3)	3	6	9	German or French	77 or 71 / 99	(3)	3	6	9
Latin or A. & M. Civil	45 or 54a / 47	(3)	3	6	9	Latin or A. & M. Civil	46 or 54b / 47	(3)	3	6	9
Greek or Chem.&Lab.	55 or 64 / 390, 392	(3)	3	6	9	Greek or Chem.	56 or 64 / 395, 397	(3)	3	6	9
M.S. & P.E.	470, 500	(2)	4	2	6	M.S. & P.E.	470, 500	(2)	4	2	6
		17	19	32	51			17	19	32	51

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
English	123	(3)	3	6	9	English	124	(3)	3	6	9
Economics	16	(3)	3	6	9	Economics	17	(3)	3	6	9
Latin or Greek or Phys.	48 / 57 / 331	(3)	3	6	9	Latin or Greek or Phys.	49 / 58 / 331	(3)	3	6	9
German or French	78 or 77 / 100	(3)	3	6	9	German or French	79 or 77 / 101	(3)	3	6	9
M.S. & P.E.	471, 500	(2)	4	2	6	M.S. & P.E.	471, 500	(2)	4	2	6
Electives		(3)	3	6	9	Electives		(3)	3	6	9
		17	19	32	51			17	19	32	51

JUNIOR YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Psychology	1	(3)	3	6	9	Psychology	2	(3)	3	6	9
French or German	90 / 70	(3)	3	6	9	French or German	90 / 71	(3)	3	6	9
Biology	292	(3)	5	4	9	Gen. Geology	268	(2)	2	3	5
Physical Ed.	500	(1)	2	0	2	Geol. Lab.	269	(1)	2	2	4
Electives		(6)	6	12	18	Physical Ed.	500	(1)	2	0	2
						Electives		(6)	6	12	18
		16	19	28	47			16	18	29	47

SENIOR YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Philosophy	8	(2)	2	4	6	Philosophy	9	(2)	2	4	6
French or German	97 / 77	(3)	3	6	9	French or German	97 / 77	(3)	3	6	9
Physical Ed.	500	(1)	2	0	2	Physical Ed.	500	(1)	2	0	2
Electives		(10)	10	20	30	Electives		(10)	10	20	30
		16	17	30	47			16	17	30	47

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

ELECTIVE STUDIES

In order that elective subjects may be incorporated, so far as possible, in the University roster from term to term without conflicts, students are required to submit their electives to the Professor in charge of electives, for the first term on or before May 1, for the second term on or before December 15.

SOPHOMORE ELECTIVES

FIRST TERM		SECOND TERM	
Advanced Algebra (4)	143	Plane Analytic Geom. (3)	145
European History (3)	41	European History (3)	42
Elementary Mechanics (3)	320	Mechanics & Heat (3)	321
Latin (3)	48	Physical Measurements (1)	322
Greek (3)	64 or 65	Latin (3)	49
Advanced Chemistry (3)	398	Greek (3)	64 or 65
Economic Geography (3)	35	Advanced Chemistry (3)	399
Physiography (2)	277	Economic Geography (3)	35
French (3)	92	Physiography (2)	278
or German (3)	70	French (3)	92
Education (3)	11	or German (3)	71
English (3)	132	Scientific Method (3)	10
		Spherical Trigonometry (1)	142
		Stoichiometry (1)	397
		English (3)	133
		Education (3)	12

JUNIOR ELECTIVES

FIRST TERM		SECOND TERM	
U. S. History (3)	39	U. S. History (3)	40
Latin (3)	50 or 52	Latin (3)	51 or 53
Greek (3)	55, 59 or 61	Greek (3)	56, 60 or 62
French (3)	98, 100 or 102	French (3)	99, 101 or 102
or German (3)	78, 77 or 80	or German (3)	79, 77 or 80
Spanish (3)	110	Spanish (3)	110
Dif. Cal. & S. A. Geom. (4)	146	Integral Calculus (4)	147
Higher Algebra (1)	144	Physics (3)	333
Physics (3)	333	Quantitative Analysis(5)	404,405
Quantitative Analysis(5)	400,402	Constitutional Law (3)	33
Constitutional Law (3)	33	Comparative Anatomy (3)	293
English (3)	126, 129, 130 or 132	English (3)	128, 131, 133 or 134
Mineralogy (4)	266	Education (3)	14
Education (3)	13	Education (1-3)	16
Education (1-3)	16	Italian (3)	117
Italian (3)	117	Economic Geography (3)	36
Economic Geography (3)	36	Business Law (2)	32
Business Law (2)	31	Labor Legislation (3)	23
Labor Legislation (3)	23	Geological Lab. (2)	269

SENIOR ELECTIVES

FIRST TERM		SECOND TERM	
Latin (3)	50 or 52	Latin (3)	51 or 53
Greek (3)	57, 59 or 61	Greek (3)	58, 60 or 62
German (3)	81 or 82	German (3)	81 or 82
French (3)	100, 102, 103 or 104	French (3)	101, 102, 103 or 104
Italian (3)	118	Italian (3)	118
Spanish (3)	114	Spanish (3)	114
English (3)	126, 129, 130 or 132	English (3)	128, 131, 132 or 134
Organic Chemistry (5)	408, 409	Organic Chemistry (4)	410
Banking (3)	27	Organic Chem. Lab. (3)	411
Education (1-3)	16	Banking (3)	27
Psychology (3)	3	Education (3)	15
Embryology (3)	294	Education (1-3)	16
Bacteriology (2)	296	Botany (3)	290
Experimental Psychology (1)	7	Physiology (2)	298
Finance (3)	19	Advanced Bacteriology (2)	297
International Law (3)	34	Psychology (3)	4
Physics (3)	334 or 335	Experimental Psychology (1)	7
Physics Lab. (2)	337	Finance (3)	19
Analytic Mechanics (2)	149	International Law (3)	34
Field Geology (3)	275	Physics (3)	334 or 336
Petrography (2)	276	Physics Lab. (2)	337
Differential Equations (1)	148	Astronomy (3)	150
Adv. Elec. & Mag. (2)	327	Paleontology (3)	272
Electrical Laboratory (1)	328	Geology of N. A. (3)	273
Economic Thought (3)	24	Electrical Laboratory (1)	329
		Analytic Mechanics (3)	152
		Economic Thought (3)	24

Figures in parentheses indicate number of credit hours a week. Other figures indicate course numbers.

PREPARATION FOR ENGINEERING COURSES

If a student in the College of Arts and Science contemplates becoming a candidate for a degree in technology after completion of his B.A. course, he should choose as electives during the third and fourth years of his B.A. course such science studies as are contained in the first and second years of the technical course which he wishes afterwards to complete. By carefully selecting electives, with the advice and guidance of the head of his department and the professor in charge of the technical course concerned, the graduate of the B.A. course may enter the technical course chosen as a Junior in full standing, and obtain his technical degree in two years of further study.

PRE-MEDICAL COURSES

Certain medical schools require for entrance a college course in addition to a high school course; others require a high school course yielding fourteen or more college entrance credits and at least two years in a college of liberal arts with about three-fourths of the study devoted to chemistry, physics and biology.

The following four-year course has been prepared for students who intend to enter a medical school, but plan, before doing so, to complete their college course and obtain their degree.

THE PRE-MEDICAL COURSE

FRESHMAN YEAR

FIRST TERM N	C	R	P	T	SECOND TERM N	C	R	P	T
English 120, 121	(3)	3	6	9	English 122, 125	(3)	3	6	9
Plane Trig. 141	(3)	3	6	9	Solid Geom. 140	(3)	3	6	9
German ....77 or 70 or French 98	(3)	3	6	9	German ....77 or 71 or French 99	(3)	3	6	9
Latin or ...45 or 54a A. & M. Civil...47	(3)	3	6	9	Latin or ...46 or 54b A. & M. Civil.. 47	(3)	3	6	9
Chemistry 390 or 393	(2)	2	4	6	Qual. Anal. 395	(2)	6	1	7
Chem. Lab. 391or393a	(2)	6	0	6	Stoichiometry ...397	(1)	1	1	2
M.S. & P.E...470, 500	(2)	4	2	6	M.S. & P.E...470, 500	(2)	4	2	6
	18	24	30	54		17	23	28	51

SOPHOMORE YEAR

FIRST TERM N	C	R	P	T	SECOND TERM N	C	R	P	T
English 123	(3)	3	6	9	English 124	(3)	3	6	9
German .....78 or 77 or French 100	(3)	3	6	9	German .....79 or 77 or French 101	(3)	3	6	9
Economics 16	(3)	3	6	9	Economics 17	(3)	3	6	9
Physics 331	(3)	5	4	9	Physics 331	(3)	5	4	9
Adv. Chem. 398	(3)	3	3	6	Adv. Chem. 399	(3)	3	6	9
M.S. & P.E...471, 500	(2)	4	2	6	M.S. & P.E...471, 500	(2)	4	2	6
	17	21	27	48		17	21	30	51

JUNIOR YEAR

FIRST TERM N	C	R	P	T	SECOND TERM N	C	R	P	T
Psychology 1	(3)	3	6	9	Psychology 1	(3)	3	6	9
French .....90 or 98 or German 70	(3)	3	6	9	French .....90 or 99 or German 71	(3)	3	6	9
Biology 292	(5)	9	6	15	Comp. Anat. 293	(3)	5	4	9
Quant. Anal. 400	(3)	9	0	9	Quant. Anal. 404	(3)	9	0	9
Quant. An. Conf..402	(1)	1	2	3	Quant. An. Conf..405	(1)	1	2	3
Physics 332	(2)	2	4	6	Physics 332	(2)	2	4	6
Physical Ed. 500	(1)	2	0	2	Physical Ed. 500	(1)	2	0	2
	18	29	24	53		16	25	22	47

FIRST TERM	N	C	R	P	T	SENIOR YEAR	SECOND TERM	N	C	R	P	T
Philosophy	8	(2)	2	4	6		Philosophy	9	(2)	2	4	6
French ....97 or 100							French ....97 or 101					
or German	77	(3)	3	6	9		or German	77	(3)	3	6	9
Org. Chem.....	408	(3)	3	6	9		Org. Chem.	410	(4)	4	5	9
Org. Chem. Lab..	409	(2)	6	0	6		Org. Chem. Lab..	411	(2)	6	0	6
Embryology	294	(3)	5	4	9		Botany	290	(3)	4	4	8
Bacteriology	296	(2)	3	3	6		Psychology	4	(3)	3	6	9
Physical Ed.	500	(1)	2	0	2		Physical Ed.	500	(1)	2	0	2
			16	24	23	47				18	24	25	49

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

For students who cannot devote four years to college work, preparatory to entering upon the study of medicine, there may be arranged upon consultation, a course which will give the student the credits demanded by the medical schools for admission.

PREPARATION FOR TEACHING

In the course leading to the degree of Bachelor of Arts, outlined on pages 32 to 36, the student may, through a selection of suitable electives, equip himself to teach in high school the subject or subjects he has selected as his specialty, whether in the field of English, of ancient or modern language, of history and social science, of biology and chemistry, of physics and mathematics, or of physiography and related subjects. In the course in Business Administration he is permitted to substitute, during the Junior and Senior years, courses in distinctly pedagogical subjects sufficient to make a total of eighteen term hours. He may thus equip himself to teach in secondary schools the important branches of commerce and industry.

No one may teach in the public schools of any state without first securing a license from that state. In Pennsylvania, as in most states, the special examination for such a license is waived in the case of college graduates, provided they have completed a certain number of hours in distinctly pedagogical studies, and have applied for a provisional college certificate to teach. At the end of three years of successful experience in teaching the State of Pennsylvania issues a permanent college certificate.

The requirement in this State for a provisional college graduate certificate to teach is as follows:

Professional Training,	Eighteen semester hours.
Introduction to Teaching,	Three semester hours.
Educational Psychology,	Three semester hours.
Practice Teaching,	Six semester hours.
Elective professional studies,	Six semester hours.
Study of subject matter,	Twelve semester hours in each subject in which the candidate desires certification.

The course in Education at Lehigh University amply meets these requirements. It may be outlined thus:

FIRST TERM	SOPHOMORE YEAR	SECOND TERM	
Introduction to Teaching	(3)	History of Education	(3)
FIRST TERM	**JUNIOR YEAR**	**SECOND TERM**	
General Psychology	(3)	Educational Psychology	(3)
Principles of Secondary Education	(3)	School Efficiency	(3)
Practice Teaching	(1)	Practice Teaching	(1)
FIRST TERM	**SENIOR YEAR**	**SECOND TERM**	
Special Method	(1) or (2)	Special Method	(1) or (2)
Practice Teaching	(2)	Problems of Secondary Education	(3)
Educational Psychology (advanced)	(3)	Practice Teaching	(2)

While all these courses ordinarily are given each year, it should be understood that to secure the Provisional College Certificate to teach in Pennsylvania High Schools, a student need complete only the following:

Introduction to Teaching, Educational Psychology, for which General Psychology is a prereqisite, Practice Teaching, and two of the following: Principles of Secondary Education, Special Method, History of Education, Problems of Secondary Education, School Efficiency and Advanced Educational Psychology.

Through the courtesy and public spirit of the Boards of Education, superintendents of schools, and principals and teachers of the neighboring high schools, the plan of practice teaching outlined under course 16 has worked out very well. In these schools may be found not only modern well equipped buildings, but also excellent organization, teachers well-fitted to serve as models and critic teachers for students in education.

Here also students of Lehigh University are cordially welcomed, and have abundant opportunity for observation, with some facilities for practice.

THE PERSONAL FACTOR

Students who expect to teach upon graduation are urged to get in touch with the Department of Education early in their college career. The proper selection of studies is of great importance to future success, and by the beginning of the Sopho-

more year the student should, if possible, decide upon one subject for his specialty and a second subject, preferably though not necessarily related to the first, for a second string to his bow. While the State requires only that twelve semester hours be given to each subject in which the applicant will be certificated, it is safe to say that the specialty should receive not much less than twice this amount of attention.

It is desirable that during the Junior year, the student should secure the thorough review of the elements of his specialty that is furnished by the courses in Special Method. The best practice-teaching cannot be done by a man who is weak in the fundamentals of his subject through lack of recent review.

The department has prepared a "self-estimate" card, which enumerates the qualities that are most important in a teacher and some of the defects that are most dangerous. The student is encouraged to rate himself, and study how to make the most of his talents, and how to remedy his defects. Appearance and manner, the use of English, self-control, interest in and sympathy with other people, and especially with the young, physical health, interest in the sports and other activities of high school students, ideals of scholarship, loyalty and co-operation, professional purpose—these are some of the personal elements which a student who hopes to teach is invited to study in this way.

PHYSICAL EDUCATION

Whether in large or small high schools, the young teacher often finds opportunity to guide his pupils in wholesome sport and recreation. Not only the Department of Physical Education but that of Military Science and Tactics is giving to students training that should greatly add to their value in the teaching profession.

THE COLLEGE OF BUSINESS ADMINISTRATION

Requirements for admission to the College of Business Administration are given on page 19.

The aim of the Course in Business Administration is to provide a sound understanding of the structure, organization and functioning of industry, commerce and finance, and of the general causes and criteria of prosperity and depression. A study is made of the functions common to all business enterprises and of the general principles of administration. The student is shown the relation of the business executive to the various factors of business organization and control.

In addition to providing a broad training for business, this course gives opportunity to specialize in some one branch of business and to prepare for the study of law and for public service. The following groupings of subjects suggest the opportunities for specialized work:

PREPARATION FOR THE LAW

Advisers: Professor Stewart and Assistant Professor Brown

Business Law
Constitutional Law
International Law
Economics
Accounting Theory and Practice
Corporation Accounting
Statistics
Finance
Banking and Currency
Investments
Labor Legislation and Administration
Transportation
Psychology

ACCOUNTANCY

Advisers: Professor Stewart and Associate Professor Bickley

Accounting Theory and Practice
Corporation Accounting
Cost Accounting
Economics
Business Law
Constitutional Law
Statistics
Finance
Banking and Currency
Investments
Industrial Management
Transportation

FINANCE, BANKING AND INVESTMENT BUSINESS

Advisers: Professor Stewart and Assistant Professor Curtis

Finance
Banking and Currency
Investments
Statistics
Economics
Accounting Theory and Practice
Corporation Accounting
Business Law
Transportation
Constitutional Law
Economic Geography
Industrial Management
Labor Legislation and Administration

INDUSTRIAL ADMINISTRATION

Advisers: Professor Stewart and Associate Professor Bickley

Accounting Theory and Practice
Corporation Accounting
Cost Accounting
Economics
Industrial History
Economic Geography
Engineering Drawing
Psychology
Industrial Management
Labor Legislation and Administration
Business Law
Constitutional Law
Transportation
Statistics
Finance
Investments
Electives from Courses in Engineering and Chemistry

FOREIGN TRADE

Advisers: Professors Stewart and Fox, Assistant Professor Curtis

Economic Geography of the Western Hemisphere
Economic Geography of the Eastern Hemisphere
Economics
Spanish
Statistics
Business Law
International Law
Constitutional Law
Finance
Banking and Currency
Investments
Accounting Theory and Practice
Corporation Accounting

The methods of instruction are directed to producing, so far as college training can do it, educated young men with a taste for business. Each student is trained to work and think for himself. He is put on the track of the best that is written on all sides of all important questions that fall within the range of the investigations, and if he holds an opinion he is expected to know on what grounds and to be able to express them. One of the results desired is modesty of opinion and an open-mindedness which leaves room for future growth.

The work of the College covers four years. On its completion the degree of Bachelor of Science in Business Administration is given.

THE COURSE IN BUSINESS ADMINISTRATION

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T
English	120, 121	(3)	3	6	9
Spanish or Portuguese	110 or 111; 115	(3)	3	6	9
Indus. Hist.	38	(4)	4	8	12
Plane Trig.	141	(3)	3	6	9
Engr. Draw.	160	(3)	7	1	8
M.S. & P.E.	470, 500	(2)	4	2	6
		18	24	29	53

SECOND TERM	N	C	R	P	T
English	122, 125	(3)	3	6	9
Spanish or Portuguese	110 or 111; 115	(3)	3	6	9
Indus. Hist.	38	(4)	4	8	12
Solid Geom.	140	(3)	3	6	9
Engr. Draw.	161	(2)	5	1	6
M.S. & P.E.	470, 500	(2)	4	2	6
		17	22	29	51

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T
Physiography	277	(2)	2	4	6
Accounting	20	(3)	3	6	9
Const. Law	33	(3)	3	6	9
Economics	16	(3)	3	6	9
Ec. Geog. N. & S. A.	35	(3)	3	6	9
Spanish or Portuguese	112 or 113; 116	(3)	3	6	9
M.S. & P.E.	471, 500	(2)	4	2	6
		19	21	36	57

SECOND TERM	N	C	R	P	T
Physiography	278	(2)	2	4	6
Accounting	20	(3)	3	6	9
Const. Law	33	(3)	3	6	9
Economics	17	(3)	3	6	9
Ec. Geog. N. & S. A.	35	(3)	3	6	9
Spanish or Portuguese	112 or 113; 116	(3)	3	6	9
M.S. & P.E.	471, 500	(2)	4	2	6
		19	21	36	57

JUNIOR YEAR

FIRST TERM	N	C	R	P	T
Bus. Law	31	(2)	2	4	6
U. S. Hist.	39	(3)	3	6	9
Labor Legis.	23	(3)	3	6	9
Transportation	22	(2)	2	4	6
Statistics	26	(3)	3	6	9
Corp. Acct. (Elec.)	21	(3)	3	9	12
Corp. Fin. (Elec.)	18a	(3)	3	8	11
Ec. Geog. E. H.	36	(3)	3	6	9
Psychology	5	(2)	2	4	6
Physical Ed.	500	(1)	2	0	2
		19	20	36	56

SECOND TERM	N	C	R	P	T
Bus. Law	32	(2)	2	4	6
U. S. Hist.	40	(3)	3	6	9
Labor Legis.	23	(3)	3	6	9
Transportation	22	(2)	2	4	6
Statistics	26	(3)	3	6	9
Corp. Acct. (Elec.)	21	(3)	3	9	12
Corp. Fin. (Elec.)	18a	(3)	3	8	11
Ec. Geog. E. H.	36	(3)	3	6	9
Psychology	2	(2)	2	4	6
Psychology	6	(2)	2	4	6
		19	20	36	56

SENIOR YEAR

FIRST TERM	N	C	R	P	T
Finance	19	(3)	3	6	9
Bank. & Cur.	27	(3)	3	6	9
Investments	25	(3)	3	6	9
Audit. (Elec.)	21a	(3)	3	9	12
European Hist.	41	(3)	3	6	9
Internat. Law.	34	(3)	3	6	9
Econ. Thought	24	(3)	3	6	9
Physical Ed.	500	(1)	2	0	2
		19	20	36	56

SECOND TERM	N	C	R	P	T
Finance	19	(3)	3	6	9
Bank. & Cur.	27	(3)	3	6	9
Investments	25	(3)	3	6	9
Cost Acct. (Elec.)	21b	(3)	3	9	12
European Hist.	42	(3)	3	6	9
Internat. Law.	34	(3)	3	6	9
Econ. Thought	24	(3)	3	6	9
Thesis	44a	(3)	0	9	9
Physical Ed.	500	(1)	2	0	2
		22	20	45	65

Students may, with the approval of the Faculty, substitute for some of the subjects in the Junior and Senior Years, other subjects which will better suit their future aims.

Prospective teachers should in this connection read the statement concerning Courses for Teachers.

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

THE COLLEGE OF ENGINEERING

THE COURSE IN CIVIL ENGINEERING

The requirements for admission to the course in Civil Engineering are given on page 19.

The purpose of this course is to give a broad education in those general and scientific subjects which form the foundation of all engineering, and a special training in the field of Civil Engineering which covers the building of highways, railroads, harbors, docks and terminals, bridges, buildings, foundations, subways, tunnels, water supply and purification plants, sewerage systems and sewage disposal plants, water power development and surveying. The Department aims to teach young men how to think and how to attack new problems, to impress upon them the underlying principles of engineering and to inspire them with the desire to do their best work.

To enable the Civil Engineering graduate to deal with allied engineering problems arising in most Civil Engineering projects of today, the course includes certain special studies such as dynamos and motors, alternating currents, heat engines, metallurgy, mineralogy and geology. Courses in Business Administration, comprising economics, accounting, business law and finance, have been placed in the curriculum with the idea that the graduate should have a knowledge of the fundamentals of business. These business subjects should prove useful to young graduates whose advancements may be along sales, managerial and executive channels. The general scope of the Civil Engineering curriculum, including as it does mathematics, pure and applied science, general engineering and business subjects, affords a thorough training in system, arrangement of work, accuracy in figures and logical thinking, so that the student has not only the proper training to enter the engineering profession, but also any business organization, should he not care to strictly follow engineering work.

The first two years are devoted mostly to fundamental studies which give both general culture and prepare for the technical work of the following years. These studies include the various branches of pure mathematics, physics, chemistry, English, modern languages, drawing, descriptive geometry, mineralogy, geology and military science and tactics.

In the summer school, at the close of the Sophomore year, Land, Topographic and Railroad Surveying is given. This covers a period of five weeks, and by this arrangement the attention of students is concentrated upon surveying, thus enabling practical field operations to be exemplified in the best manner. In Geodetic Surveying, given in the Senior year, triangulations of a high degree of precision are executed. Also determinations of azimuth and adjustments of results are made by standard methods. A large collection of levels, transits and other surveying instruments enables the student to become familiar with instruments of the best type.

Strength of Materials, which presents the theory of beams, columns and shafts, and the method of computing and designing them, is given in the Junior year. Laboratory tests are made of timber, brick, iron and steel. Strength of Materials as here presented may be described as applied mechanics, that is, the application of mechanics to the design of engineering structures. The testing of materials is of great importance for the student's understanding of the mechanics of engineering and for the capacity it gives him to manipulate apparatus and to handle machines.

Roofs and Bridges receive attention throughout three terms. Analytical and graphic methods of determining stresses are taken up in Roofs and Bridges of the second term of the Junior year and in Bridge and Structural Design and Higher Structures of the Senior year. Visits are made to bridges and to bridge shops. In the Senior year designs and working drawings are prepared by each student for both a highway and a railroad bridge. Some of these drawings are made in the same manner as in drawing rooms of bridge companies and others are general, that is, design drawings only. The theory of cantilever, draw, suspension and arch structures receives detailed attention. Structural Steel Design as applied to building construction is studied in detail. The design and construction of reinforced concrete and foundations are given in the second term of the Senior year in the course in Reinforced Concrete Design and Foundations. This extended training in structural engineering furnishes a foundation for structural steel and reinforced concrete work in practice.

Hydraulic Engineering and Sanitary Engineering are treated at length. The theory of the flow of water through orifices, weirs, pipes and channels together with the principles of hydraulic motors is given in the Junior year, the work being supplemented by testing in the hydraulic laboratory. In the Senior year the subjects of water supply, water power and sewerage are covered in detail. The methods of collecting, purifying and distributing water are explained and compared; housedrainage, the design of sewerage systems and the disposal of sewage also receive attention. Computations for dams, standpipes, sewers and other appurtenances are made. Canal engineering, river and harbor work and land drainage are studied; irrigation by both water and sewage are discussed. This training in Hydraulics and Sanitary Engineering subjects, including Sanitary Biology of the Senior year, is planned to enable a graduate to enter upon the work of city engineering. In connection with the course in Hydraulics, measurements are made of the flow in the Lehigh River, the Lehigh Canal and other streams in the vicinity of Bethlehem and the data thus obtained are studied later and reports written thereon. In view of the increasing importance of water power development this work is of value and interest.

The contents of the courses in Highway Engineering and Railroads are planned to prepare a student to enter the field of highway construction and design, and railroad work.

Contracts and Specifications of the second term of the Senior year is presented by the Civil Engineering Department more from the engineering than from the legal viewpoint. This course, consisting of two lectures a week, gives the essential features of contracts and the form and scope of contracts and specifications as used in building engineering works.

A description of the Fritz Engineering Laboratory which is operated by the Civil Engineering Department is given in this Register under the heading of Buildings.

The student who completes the course receives the degree of Civil Engineer (C.E.). Mature young men, if properly qualified, may take special studies without being candidates for the degree.

THE COURSE IN CIVIL ENGINEERING

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T
Adv. Algebra	143	(4)	4	8	12
Chemistry .390 or 393		(2)	2	4	6
Chem. Lab. 391or393a		(2)	6	0	6
El. Mechanics	320	(3)	3	5	8
French 94 / or German 75 / or Spanish 111		(3)	3	6	9
English	120	(2)	2	2	4
M.S. & P.E.	470, 500	(2)	4	2	6
			18	24	27	51

SECOND TERM	N	C	R	P	T
P. Anal. Geom.	145	(3)	3	6	9
Qual. Anal.	395	(2)	6	1	7
Stoichiometry	397	(1)	1	1	2
El. Mechanics	321	(3)	3	4	7
Phys. Measure	322	(1)	3	2	5
French 94 / or German 75 / or Spanish 111		(3)	3	5	8
English	122	(2)	2	2	4
Drawing	162	(1)	3	0	3
M.S. & P.E.	470, 500	(2)	4	2	6
			18	28	23	51

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3)

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T
Cal. & S.A.Geom.	146	(4)	4	8	12
Elec. & Mag.	323	(3)	3	4	7
M. & H. Lab.	324	(1)	2	1	3
Mineralogy	266	(4)	6	3	9
Heat Eng.	221	(3)	3	6	9
Engr. Drawing	163	(3)	7	1	8
M.S. & P.E.	471, 500	(2)	4	2	6
			20	29	25	54

SECOND TERM	N	C	R	P	T
Int. Calculus	147	(4)	4	8	12
Light & Sound	325	(3)	3	4	7
L., E. & M. Lab.	326	(1)	2	1	3
Gen. Geology	268	(2)	2	3	5
Geol. Lab.	269	(2)	4	3	7
Heat Eng.	222	(3)	3	6	9
Engr. Drawing	164	(2)	5	0	5
M.S. & P.E.	471, 500	(2)	4	2	6
			19	27	27	54

SUMMER TERM: Land and Topographic Surveying, 165, 3 weeks (1½); Railroad Surveying, 166, 2 weeks (1½)

JUNIOR YEAR

FIRST TERM	N	C	R	P	T
Str. of Mat.	167	(4)	4	8	12
Str. Mat. Lab.	168	(1)	3	0	3
Anal. Mech.	149	(2)	2	4	6
Railroads	169	(4)	8	2	10
Metallurgy	247	(3)	3	4	7
Dyn. & Mot.	354	(2)	2	4	6
Dyn. Lab.	355	(1)	3	1	4
Physical Ed.	500	(1)	2	0	2
			18	27	23	50

SECOND TERM	N	C	R	P	T
Hydraulics	170	(3)	3	6	9
Hyd. Lab.	171	(1)	3	0	3
Roofs & Bridges	172	(4)	4	8	12
Astronomy	150	(3)	3	6	9
Alt. Cur.	375	(2)	2	4	6
Dyn. Lab.	356	(1)	3	1	4
Highway Engr.	173	(3)	5	2	7
Physical Ed.	500	(1)	2	0	2
			18	25	27	52

SUMMER TERM: Shop Work or Engineering Construction, with report, 187, 8 weeks (3)

SENIOR YEAR

FIRST TERM	N	C	R	P	T
Str. Steel Des.	175	(3)	3	6	9
Br. Des. Dr.	177	(3)	9	0	9
Hyd.& W.P. Engr.	179	(4)	5	7	12
Geodesy	180	(3)	6	2	8
or Pract. Astr.	151	(3)	3	6	9
Bus. Engr	30a	(3)	3	3	6
R. R.s & Ter.	181	(3)	3	3	6
Physical Ed.	500	(1)	2	0	2
			20	31	21	52

SECOND TERM	N	C	R	P	T
Higher Structures.	182	(3)	3	6	9
R. Con. D. & F.	183	(3)	3	6	9
Cement Lab.	184	(1)	3	0	3
San. Engr.	186	(3)	3	6	9
San. Biol.	295	(2)	3	5	8
English	137	(3)	3	3	6
or Con. & Spec.	185	(2)	2	4	6
Bus. Engr.	30a	(3)	3	3	6
Physical Ed.	500	(1)	2	0	2
			19	23	29	52

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

THE COURSE IN MECHANICAL ENGINEERING

The requirements for admission to the Course in Mechanical Engineering are given on page 19.

The purpose of this course is to give young men a broad and thorough training in the fundamental subjects which underlie all engineering.

The Freshman year is given to fundamental studies in preparation for the technical work of the following years and to studies of general cultural value. The former comprise Advanced Algebra, Analytic Geometry, Elementary Chemistry with laboratory exercises, Qualitative Analysis, Stoichiometry, Elementary Mechanics, Heat, and laboratory work in Physical Measurements. The general studies are English, Military Science and Tactics, and modern languages,—French, German or Spanish. Students continue the language accepted for entrance.

At the close of the Freshman year, students attend the R. O. T. C. encampment for six weeks and hand in a report on the work at the beginning of the Sophomore year.

In the Sophomore year the following courses are given: Differential Calculus, Solid Analytic Geometry, Integral Calculus, Electricity and Magnetism, Light and Sound, Mechanism, Mechanical Drawing, Elementary Machine Design, and Steam Engines. The laboratory course covers mechanics, heat, light, electricity and magnetism. Military Science and Tactics is continued.

At the close of the Sophomore year students are required to spend eight weeks in an industrial plant and hand in a report at the beginning of the Junior year.

The courses given in the Junior year are Differential Equations, Analytic Mechanics, Strength of Materials, Graphic Statics of Mechanisms, Advanced Electricity and Magnetism, Heat Engines, Hydraulics, Metallurgy, Graphic Statics of Structures and Dynamos and Motors. Courses are given in Engineering Laboratory and Electrical Laboratory; laboratory courses also accompany the study of Strength of Materials and Hydraulics.

At the close of the Junior year students are required to spend at least eight weeks on student apprenticeship work, shop work, or engineering construction as approved by the Department. A report is required.

The courses of the Senior year are Machine Design, Alternating Currents and Electrical Engineering, both accompanied by laboratory work, Mechanical Engineering, English, Business Engineering and Engineering Laboratory. A thesis is required.

The course in Mechanical Engineering is built upon the work of the Sophomore and Junior years and consists of Thermodynamics, Steam Turbines, Internal Combustion Engines, Air Machinery, Pumping Machinery and Refrigeration.

The course in Business Engineering comprises the elements of Economics, Accounting, Business Law and Finance.

Instruction in Machine Design is given throughout the Sophomore year. There is a thorough drill in projection drawing. Freehand sketches are first made and measurements taken of machine pieces; these sketches are then converted into full-sized drawings. There is then considerable practice in the interpretation of such drawings. This is followed by difficult projections and intersections and exercises in the proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice. In their Senior year the students undertake the calculations, estimates and working drawings involved in the design of simple but complete machines, the general plan of arrangement being given in the form of rough sketches, photographs or wood cuts. In the second term the Seniors make original designs for simple machinery.

After completing the general course in Physics, students in Mechanical Engineering take courses along electrical lines. The aim is a clear conception of electrical units and a working knowledge of resistance, impedance, reactance, capacity, the magnetism of iron and the magnetic circuit as used in the construction of electrical machinery. Attention is then di-

rected to the theory and calculation of direct current dynamos, to the study of variable and alternating current phenomena and to the theory of the alternating current apparatus. Practical problems show their application. The laboratory work involves tests of resistance, insulation, consumption of energy and efficiency.

The course in Engineering Laboratory begins with the handling and calibration of the instruments and appliances belonging to the experimental side of mechanical engineering. The simpler tests and experiments are taken up next, and there is a gradual progress toward complex operations such as the complete test of a power plant or pumping station, or a full thermodynamic test of the steam engine. The course is, at present, most fully developed in the field of steam engineering, where it embraces steam calorimetry, flow of steam, the testing of steam traps and separators; of injectors, pumps, and the steam turbine; extensive practice with the indicator, engine tests of various sorts and boiler testing.

Due place is given in the course to gas engineering, tests of gas producers, gas engines and oil engines, work with compressed air, tests of hot-air engines and various incidental appliances and apparatus. Dynamometer work includes experiments in friction and lubrication and determination of the efficiency of machines. The purpose of this course is to provide a system of well-selected and graded experiments which will illustrate and impress principles, develop the skill and judgment of the student and give training in the idea, method and detail of this sort of work.

In the Senior year one or two trips are made to New York or Philadelphia during which visits of inspection are made to power plants, municipal works, ship yards and a variety of industrial plants located in these cities or vicinity.

Graduates of this course receive the degree of Mechanical Engineer (M.E.).

THE COURSE IN MECHANICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T
Adv. Algebra	143	(4)	4	8	12
Chemistry	390 or 393	(2)	2	4	6
Chem. Lab.	391or393a	(2)	6	0	6
El. Mechanics	320	(3)	3	5	8
French or German or Spanish	94 / 75 / 111	(3)	3	6	9
English	120	(2)	2	2	4
M.S. & P.E.	470, 500	(2)	4	2	6
			18	24	27	51

SECOND TERM	N	C	R	P	T
P. Anal. Geom.	145	(3)	3	6	9
Qual. Anal.	395	(3)	9	1	10
Stoichiometry	397	(1)	1	1	2
El. Mechanics	321	(3)	3	4	7
Phys. Measure	322	(1)	3	2	5
French or German or Spanish	94 / 75 / 111	(3)	3	5	8
English	122	(2)	2	2	4
M.S. & P.E.	470, 500	(2)	4	2	6
			18	28	23	51

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3)

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T
Cal. & S.A.Geom.	146	(4)	4	8	12
Elec. & Mag.	323	(3)	3	4	7
M. & H. Lab.	324	(1)	2	1	3
Dr. and El.M.Des.	200	(3)	3	6	9
Heat Eng.	201	(3)	3	6	9
Mechanism	202	(3)	3	5	8
M.S. & P.E.	471, 500	(2)	4	2	6
			19	22	32	54

SECOND TERM	N	C	R	P	T
Int. Calculus	147	(4)	4	8	12
Light & Sound	325	(3)	3	4	7
L., E. & M. Lab.	326	(1)	2	1	3
El. Mach. Des.	203	(3)	3	6	9
Heat Eng.	204	(3)	3	6	9
Mechanism	205	(3)	3	5	8
M.S. & P.E.	471, 500	(2)	4	2	6
			19	22	32	54

SUMMER TERM: Work in Industrial Plant, with report, 227, 8 weeks (3)

JUNIOR YEAR

FIRST TERM	N	C	R	P	T
Diff. Equations	148	(1)	1	3	4
Anal. Mech.	149	(2)	2	4	6
Str. of Mat.	167a	(3)	3	6	9
Str. Mat. Lab.	168	(1)	3	0	3
Gr. St. of Mech.	206	(2)	4	0	4
Adv. Elec. & Mag.	327	(2)	2	4	6
Elec. Lab.	328	(1)	3	0	3
Heat Eng.	207	(4)	4	8	12
Engr. Lab.	208	(1)	3	0	3
Physical Ed.	500	(1)	2	0	2
			18	27	25	52

SECOND TERM	N	C	R	P	T
Metallurgy	247	(3)	3	4	7
Hydraulics	170a	(2)	2	4	6
Hyd. Lab.	171	(1)	3	0	3
Gr. St. & Surv.	174	(3)	3	6	9
Dyn. & Mot.	354	(2)	2	4	6
Elec. Lab.	329	(1)	3	1	4
Heat Eng.	209	(4)	4	8	12
Engr. Lab.	210	(1)	3	0	3
Physical Ed.	500	(1)	2	0	2
			18	25	27	52

SUMMER TERM: Student Apprenticeship or Engineering Construction or Shop Work, with report, 228, 8 weeks (3)

SENIOR YEAR

FIRST TERM	N	C	R	P	T
English	123, 125	(3)	3	3	6
Mach. Design	211	(4)	4	8	12
Alt. Currents	375	(2)	2	4	6
Dyn. Lab.	355	(1)	3	1	4
Bus. Engr.	30a	(3)	3	3	6
Mech. Engr.	212	(4)	4	8	12
Engr. Lab.	213	(1)	3	0	3
Physical Ed.	500	(1)	2	0	2
			19	24	27	51

SECOND TERM	N	C	R	P	T
Mach. Design	215	(4)	4	8	12
Elec. Engr.	361	(2)	2	4	6
Dyn. Lab.	356	(1)	3	1	4
Bus. Engr.	30a	(3)	3	3	6
Mech. Engr.	216	(4)	4	8	12
Engr. Lab.	217	(1)	3	0	3
Thesis	214	(3)	1	6	7
Physical Ed.	500	(1)	2	0	2
			19	22	30	52

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

THE COURSE IN METALLURGY

The requirements for admission to the Course in Metallurgy are given on page 19.

The object of this course is the preparation of the student for practice in the general field of metallurgy. It is recognized that the breadth of the subject is such that detailed instruction in any particular subdivision is precluded in the time limits imposed by a four-year's course. Emphasis is therefore laid on the more thorough training of the student in fundamentals. It is a fairly simple matter for a man thoroughly grounded in fundamental theory to make the necessary applications to actual practice after he gets into the field, but the acquisition of theory to bolster up a purely practical knowledge is a more difficult proposition.

The foundation of any engineering course must be a thorough training in mathematics, chemistry and physics, and every effort is made to have the work along these lines as full as the time available will permit. A large portion of the first two years of the course is occupied by these subjects, while the last two years are taken up mainly by the application of these in the various technical subjects.

Collateral studies in other departments than metallurgy are liberally provided, such as Mineralogy, Blowpiping, General Geology, Geological Practice and Economic Geology in the Department of Geology; Mechanical Drawing and Ore Dressing in the Department of Mining Engineering; Advanced Electricity and Magnetism and Electrical Laboratory in the Department of Physics; Alternating Currents, Dynamos and Motors, Electrical Engineering and Dynamo Laboratory in the Department of Electrical Engineering; Heat Engines, comprising the study of boilers, steam engines, gas engines and internal combustion motors, and Engineering Laboratory, in the Department of Mechanical Engineering; Hydraulics and Strength of Materials, with laboratory testing, in the Department of Civil Engineering.

Instruction is given in English composition, writing and public speaking. The study of German or French for one year is

required, the student continuing the language on which he enters; if a student enters with Spanish he takes one year of German. The one year of either German or French is supplemented in the Senior year by a brief but intensive course in the grammar of the other language, and by readings in Metallurgical German and French with the staff of the Department of Metallurgy.

The studies in chemistry, which are so important to the metallurgist, include Laboratory Experiments, Qualitative and Quantitative Analysis, both gravimetric and volumetric, of the more common ores and metallurgical products, including Gas Analysis and Assaying, along with courses in Stoichiometry, Advanced Chemistry, Physical Chemistry and Physical Chemistry Laboratory. This instruction, together with the course in Physics and Physical Laboratory, constitutes the foundation on which the metallurgical instruction is based.

The special instruction in Metallurgy is begun by introductory courses of lectures on the history of the metals, followed by a discussion of their economic and mechanical importance, their physical and chemical properties, including statistics of their production and details of the distribution of their ores and the geographical distribution and conditions of their production. Courses of lectures extending over two years take up in detail the general principles of metallurgy and their applications to specific cases. They begin with the general physical and chemical principles utilized in extracting metals from their ores and the manner in which they are applied, and are followed by a course of lectures on the Metallurgy of Iron and Steel, and by another course in the Metallurgy of the other metals, copper, lead, silver, gold, etc., in which each metal is discussed in detail. In order to impress these principles upon the student and to render their application familiar, he is required to solve a series of problems dealing with practical details of the metallurgical processes in an exact and quantitative manner, the data being taken from every-day commercial practice so that the results may give an insight into the quantitative relations that are fundamental to all metallurgical processes. A course of lectures follows this in the principles of electrochemistry, and their application in electrometallurgy,

accompanied by laboratory investigations of these principles as well as the general principles of metallurgical processes, including methods of making physical and chemical measurements which are of value to the practicing metallurgist. A course in Metallography acquaints the student with the methods of studying with the microscope and other instruments of precision, the physical properties, constitution and structure of metals and alloys. The seminary in the Senior year is intended to bring together the members of the Department and the students in the discussion of current metallurgical questions and problems, and students' theses.

The proximity of the works of the Bethlehem Steel Company and the kindness of its officers give opportunity for visits of inspection by the students in classes and individually, thus affording unusual facilities for the practical study of the metallurgy of iron and steel. Occasional visits of inspection are made to more distant works, in connection with the metallurgy of zinc, copper, lead, gold and silver.

Graduates of this course receive the degree of Metallurgical Engineer (Met.E.).

THE COURSE IN METALLURGY

FRESHMAN YEAR

FIRST TERM N	C	R	P	T	SECOND TERM N	C	R	P	T
Adv. Algebra....143	(4)	4	8	12	P. Anal. Geom....145	(3)	3	6	9
Chemistry .390 or 393	(2)	2	4	6	Qual. Anal. 395	(3)	9	0	9
Chem. Lab. 391or393a	(2)	6	0	6	Qual. An. Conf...396	(1)	1	2	3
El. Mechanics....320	(3)	3	5	8	Stoichiometry ...397	(1)	1	1	2
German ....72 or 76					Hist. Metals.....241	(1)	1	1	2
or French..... 94	(3)	3	6	9	El. Mechanics....321	(3)	3	4	7
English 120	(2)	2	2	4	Phys. Measure....322	(1)	3	2	5
M.S. & P.E...470, 500	(2)	4	2	6	German ....72 or 76				
					or French..... 94	(3)	3	5	8
	18	24	27	51	M.S. & P.E...470, 500	(2)	4	2	6
						18	28	23	51

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3)

SOPHOMORE YEAR

FIRST TERM N	C	R	P	T	SECOND TERM N	C	R	P	T
Cal. & S.A.Geom..146	(4)	4	8	12	Int. Calculus.....147	(4)	4	8	12
Adv. Chem.....398	(3)	3	3	6	Adv. Chem. 399	(3)	3	6	9
Elec. & Mag.....323	(3)	3	4	7	Light & Sound...325	(3)	3	4	7
M. & H. Lab.....324	(1)	2	1	3	L., E. & M. Lab..326	(1)	2	1	3
Intro. Met 242	(1)	1	1	2	Intro. Met 242	(1)	1	1	2
Drawing 300	(2)	6	0	6	Gen. Geology....268	(2)	2	3	5
Mineralogy 266	(4)	6	3	9	Geol. Lab. 269	(2)	4	3	7
B. P. Anal.....267	(1)	3	0	3	B. P. Anal.....267	(1)	3	0	3
M.S. & P.E...471, 500	(2)	4	2	6	M.S. & P.E...471, 500	(2)	4	2	6
	21	32	22	54		19	26	28	54

SUMMER TERM: Quantitative Analysis, 403a, 5 weeks (3)

JUNIOR YEAR

FIRST TERM N	C	R	P	T	SECOND TERM N	C	R	P	T
G.Met.&Probs.243,244	(3)	3	4	7	I.&S. & Probs.245,246	(3)	3	4	7
Phys. Chem. 419	(3)	3	3	6	Phys. Chem. 421	(2)	2	3	5
Ore Dr. & Lab....302	(3)	3	3	6	Dyn. & Mot. 354	(2)	2	3	5
Adv. Elec. & Mag.327	(2)	2	4	6	Dyn. Lab. 355	(1)	3	1	4
Elec. Lab. 328	(1)	3	0	3	Elec. Lab. 329	(1)	3	0	3
Heat Eng. 221	(3)	3	6	9	Heat Eng. 222	(3)	3	6	9
Str. of Mat.....167a	(3)	3	6	9	Hydraulics 170a	(2)	2	4	6
Str. Mat. Lab. ...168	(1)	3	0	3	Hyd. Lab. 171	(1)	3	0	3
Physical Ed. 500	(1)	2	0	2	English 125, 127	(4)	4	4	8
					Physical Ed. 500	(1)	2	0	2
	20	25	26	51		20	27	25	52

SUMMER TERM: Assaying, 413, 4 weeks (3)

SENIOR YEAR

FIRST TERM N	C	R	P	T	SECOND TERM N	C	R	P	T
N.F. Met.&Pr..248,249	(3)	3	4	7	N.F. Met.&Pr..250,251	(3)	3	4	7
Metallography ...257	(3)	7	1	8	Met. Lab. 256	(2)	4	2	6
El. Chem. 252	(1)	1	2	3	El. Met. 253	(1)	1	2	3
El. Chem. Lab. ...255	(1)	2	1	3	Seminary 258	(2)	3	0	3
Seminary 258	(3)	4	2	6	Elec. Engr. 361	(2)	2	3	5
Alt. Currents....375	(2)	2	3	5	Dyn. Lab. 362	(1)	3	1	4
Dyn. Lab. 356	(1)	3	1	4	Eng. Lab. 226	(1)	3	0	3
Phys. Chem. Lab.420	(1)	3	0	3	Econ. Geol. 271	(4)	5	5	10
Engr. Lab. 220	(1)	3	0	3	Thesis 259	(3)	1	8	9
French or Ger..91 or 72	(3)	3	5	8	Physical Ed. 500	(1)	2	0	2
Physical Ed. 500	(1)	2	0	2					
	20	33	19	52		20	27	25	52

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

THE COURSE IN MINING ENGINEERING

The requirements for admission to the Course in Mining Engineering are given on page 19.

The object of this course is primarily to train a student for practice in the field of mining engineering. It is designed to give him the thorough fundamental training of an engineer and a breadth of education that will enable him readily to undertake work in the various lines of engineering frequently presented to one of his profession.

The course, therefore, places the graduate in the path of a large number of opportunities. Not only will he have had sufficient practice and training to enter upon the field of mining, but he can pursue work in which geology and metallurgy play an important part, and also in related engineering projects.

In the Freshman year a foundation is laid in the fundamental subjects of mathematics, physics, chemistry, English and modern foreign languages. The modern language pursued is the one presented for entrance. Lectures are given in physiology and hygiene, also in military science and tactics. Military drill and systematic physical exercise are required. Students attend the R. O. T. C. camp at the close of the Freshman year.

The course in Drawing begins in the second term of the Freshman year. A student learns the use of drawing instruments, making tracings and blue prints, drawings of machine parts of simple construction, and solves problems in Descriptive Geometry.

The summer schools in Land and Topographic Surveying and in Mine and Railroad Surveying are held at the close of the Junior year. The second of these schools is conducted partly in the mining regions; this gives practice in mine and railroad surveying and permits a study of mining operation and mining plants, from which data are secured exemplifying class room work and facilitating the course in Mining Design of the Senior year.

The course in Chemistry begins in the first term of the Freshman year and extends to the end of the Sophomore year, with

the summer school in Assaying at the end of that year. Beginning with an introduction to general chemical theory and the elements, supplemented by laboratory work, the subject is continued by Qualitative and Quantitative Analysis. Chemical problems and reactions are taught in Stoichiometry. The instruction includes the analysis of common ores, fuels, gases and metallurgical products.

The course in Business Engineering in the Senior year aims to present to the student the several economic, commercial, administrative and legal aspects of conditions existing in the industrial world which are of particular concern to the engineering profession.

The importance of the conservation of the timber resources of the country and the preservation of wood against decay are treated in Forestry, together with the characteristics of the woods of the important timber species.

Mineralogy is introduced by a short course in Crystallography, in which models of crystals and mineral specimens are studied. The various means of identification are then applied to more difficult minerals, the determination of which may be assisted and effected by the work in Blowpipe Analysis.

In the courses in Geology, the student studies the forms and structures of the rock masses of the earth's crust, and the forces which modify them. A brief review of historical geology deals with the fossil life of the globe. Practice in Field Geology teaches the methods by which rock formations are accurately mapped. Economic Geology treats of the origin, mode of occurrence and distribution of the metallic and non-metallic minerals and substances of commercial value in the earth. The course in Petrography enables the student to identify the common rock-forming minerals by the use of the microscope, especially when the constituents are too fine-grained to be determined by the eye alone. Practice in the petrographic and geological laboratory and in the field qualifies the student to recognize the main types of rocks.

Physiography treats of the classification of land forms and their geographical distribution, their relation to geologic structure, weather and climate, and their influence upon the economic development of countries. The course in Geology of North America discusses the geologic ages and the geographic

distribution of the rocks of the continent, their structure and history, and includes studies of the great surveys that have been made. Paleontology reviews the life of past ages and involves the study and identification of fossils as a means of determining the age of rocks by the principles of stratigraphy.

The course in Heat Engines includes a practical study of boilers, steam and gas engines and steam turbines; work in the Wilbur Engineering Laboratory includes tests and calculations of efficiencies and powers under varying conditions.

Strength of Materials treats of the theories which govern the strength of all kinds of common materials used in construction. Practice is given in computing and designing beams, columns, girders, etc. Hydraulics deals with the flow of liquids through orifices, mains, pipes and channels, and with the principles of hydraulic motors; practical work in the Fritz Engineering Laboratory is a part of this course. Graphic Statics qualifies the student to compute the forces developed in roof trusses, bridges and girders by the methods of graphical analysis.

The instruction in Mining Engineering is given during the Junior and Senior years, under the following subdivisions: prospecting, boring, mining or exploitation, haulage, hoisting, drainage, ventilation, lighting, first-aid, railroads, construction materials and mine administration. These subjects treat successively of the steps by which minerals are discovered and valued, the manner in which they are extracted from the earth and brought to the surface, the manner in which accidents may occur and means for guarding against them, and the treatment of injured persons, and the means by which mines are maintained in an economical condition from the viewpoint of mine owner and miner.

The subject of Ore Dressing, supplemented by work in the Coxe Mining Laboratory, deals with the processes by which ores and fuels, direct from the mine, are rendered marketable. Construction Materials treats of the materials used in roads and structures in and around mines, particular attention being given to the use of reinforced concrete construction. Mine Administration discusses the method of employing labor and of keeping accounts, mining principles and management.

The course in Oil and Gas Technology includes a study of the occurrence and distribution of petroleum and natural gas, the

methods of prospecting, the means for obtaining them from the earth, and their storage and transportation.

In Mining Design the student employs principles studied and observations made as the basis for designs and working drawings of parts of mining plant to fulfill given conditions.

In Metallurgy the general principles of the subject embracing fuels, furnaces and processes, are presented, followed by the metallurgy of iron and steel, copper, lead, gold, silver, zinc, tin, mercury, nickel and aluminium. Electrochemistry and Electrometallurgy familiarize the student with the practical applications of electricity to metallurgical processes including electric-furnace practice. Visits of inspection are made to metallurgical plants in the vicinity, and also to those near New York City.

Dynamos and Motors and Alternating Currents extend over the entire Senior year and embrace the study of the industrial applications of electricity which are of particular value to the mining engineer; practical work in the Dynamo Laboratory is included in these courses.

It may thus be observed that the student of the Course in Mining Engineering has studies in all of the technical departments of the University, as well as in many of the arts and science departments.

The facilities for exemplifying the work of the course are exceptional. Cement mills, cement, slate and other quarries, ore and coal mines are within easy distance and in the city are the great works of the Bethlehem Steel Company. During the Junior and Senior years all students in Mining Engineering are required to make inspection trips to the anthracite coal regions and to the metal mining districts of eastern Pennsylvania and of New Jersey. A voluntary inspection trip to the mines of the central northern part of the United States and southern Ontario last summer included the Lake Superior iron and copper region.

The Department of Mining Engineering has exceptional facilities in the Eckley B. Coxe Mining Laboratory. A description of the Laboratory is given on pages 159-160 of this Register.

Graduates of this course receive the degree of Engineer of Mines (E.M.).

THE COURSE IN MINING ENGINEERING

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Adv. Algebra	143	(4)	4	8	12	P. Anal. Geom.	145	(3)	3	6	9
Chemistry .390 or 393		(2)	2	4	6	Qual. Anal.	395	(3)	9	1	10
Chem. Lab. 391or393a		(2)	6	0	6	Stoichiometry	397	(1)	1	1	2
El. Mechanics	320	(3)	3	5	8	El. Mechanics	321	(3)	3	4	7
French 94 or German 75 or Spanish 111		(3)	3	6	9	Phys. Measure	322	(1)	3	2	5
English	120	(2)	2	2	4	French 94 or German 75 or Spanish 111		(3)	3	5	8
M.S. & P.E.	470, 500	(2)	4	2	6	Drawing	300	(2)	4	0	4
						M.S. & P.E.	470, 500	(2)	4	2	6
		18	24	27	51			18	30	21	51

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3)

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Cal. & S.A.Geom.	146	(4)	4	8	12	Int. Calculus	147	(4)	4	8	12
Quant. Anal.	401	(3)	9	0	9	Quant. Anal.	403	(3)	9	0	9
Quant. An. Conf.	402	(1)	1	1	2	Quant. An. Conf.	405	(1)	1	1	2
Elec. & Mag.	323	(3)	3	4	7	Light & Sound.	325	(3)	3	4	7
M. & H. Lab.	324	(1)	2	1	3	L., E. & M. Lab.	326	(1)	2	1	3
Mineralogy	266	(4)	6	3	9	Gen. Geology	268	(2)	2	3	5
B. P. Anal.	267	(1)	3	0	3	Geol. Lab.	269	(2)	4	3	7
Drawing	300	(1)	3	0	3	B. P. Anal.	267	(1)	3	0	3
M.S. & P.E.	471, 500	(2)	4	2	6	M.S. & P.E.	471, 500	(2)	4	2	6
		20	35	19	54			19	32	22	54

SUMMER TERM: Assaying, 413, 4 weeks (3)

JUNIOR YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Mining Engr.	301	(4)	4	4	8	Mining Engr.	303	(4)	4	4	8
Ore Dr. & Lab.	302	(3)	3	3	6	Metallurgy	247	(3)	3	4	7
Str. of Mat.	167	(4)	4	8	12	Heat Eng.	222	(3)	3	6	9
Heat Eng.	221	(3)	3	6	9	Hydraulics	170	(3)	3	6	9
Petrography	276	(2)	3	2	5	Hyd. Lab.	171	(1)	3	0	3
Econ. Geol.	270	(2)	2	3	5	Physiography	274	(2)	2	2	4
Forestry	291	(2)	3	2	5	Oil & Gas Tech.	306	(2)	2	2	4
Physical Ed.	500	(1)	2	0	2	English	127	(2)	2	4	6
						Physical Ed.	500	(1)	2	0	2
		21	24	28	52			21	24	28	52

SUMMER TERM: Land and Topographic Surveying, 165, 3 weeks (1½); Mine and Railroad Surveying, 304, 3 weeks (1½)

SENIOR YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Mining Engr.	305	(3)	3	3	6	Mining Des.	307	(3)	6	1	7
N. F. Met.	248	(2)	2	2	4	Econ. Geol.	271	(4)	5	5	10
El. Chem. & Met.	254	(2)	2	3	5	N. F. Met.	250	(2)	2	2	4
Dyn. & Mot.	354	(2)	2	4	6	Alt. Cur.	375	(2)	2	4	6
Dyn. Lab.	355	(1)	3	1	4	Dyn. Lab.	356	(1)	3	1	4
Field Geol.	275	(3)	7	3	10	Geol. N. A.	273	(3)	5	2	7
Graph. Stat.	178	(2)	4	2	6	Engr. Lab.	226	(1)	3	0	3
Engr. Lab.	220	(1)	3	0	3	Mine Ad.	305	(1)	1	2	3
Bus. Engr.	30a	(3)	3	3	6	Bus. Engr.	30a	(3)	3	3	6
Physical Ed.	500	(1)	2	0	2	Physical Ed.	500	(1)	2	0	2
		20	31	21	52			21	32	20	52

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

THE COURSE IN ELECTRICAL ENGINEERING

The requirements for admission to the Course in Electrical Engineering are given on page 19.

The object of this course is to give a broad education in those general and scientific subjects which underlie all the branches of engineering, and to give special training in those technical and business subjects which experience shows are most essential in the equipment of the electrical engineer. In seeking to accomplish this object the Department puts chief emphasis upon mastery of principles and thoroughness in the analysis of problems.

The course includes a number of special studies in civil, mechanical and metallurgical engineering, so that the graduate in Electrical Engineering is prepared not only to enter any of the branches of electrical engineering but also to deal with related problems in the other branches of engineering. The electrical engineering graduate of today finds that professional advancement often lies through commercial, managerial or executive channels. As superintendent or manager of electric light, power or railway properties he must be prepared to handle problems involving not merely material and technical details but human relations, touching workmen, capitalists, public utility commissioners, and the public. He must know something of the principles of accounting, economics, business law and industrial management. A number of such studies have been introduced into the course.

The fundamental studies are given in the early part of the course and include mathematics, physics, chemistry, English and that modern language accepted for entrance. These subjects include the more essential features of a broad education and they furnish a preparation for the more advanced scientific and technical training to follow.

At the close of the Freshman year, students attend the R. O. T. C. Encampment for six weeks and hand in a report on the work at the beginning of the Sophomore year.

Work in applied electricity is pursued through the Sophomore year in the study of Electric Distribution, and Dynamos

and Motors, with Dynamo Laboratory. The Junior and Senior years are devoted almost exclusively to advanced technical work.

During each of the vacations following the Sophomore and Junior years students are required to spend at least eight weeks in an electrical industrial plant or station and hand in a written report thereon at the beginning of the next college year.

The study of Electricity and Magnetism constitutes an introduction to the industrial applications of electricity. Electric Distribution makes immediate application of electrical theory to the calculation of lighting and power circuits, the testing of insulation resistance and similar problems. The study also includes the installation and wiring of electrical machinery, systems of electrical distribution, outside and interior wiring.

The study of Dynamos and Motors includes the construction, operation and control of direct current generators and motors, with numerous illustrative problems. The study of dynamo electric machinery is resumed during the Senior year in connection with the subjects Electrical Design and Alternating Current Machinery.

Fundamental subjects in mechanical engineering are required in this course. Machine Design is given throughout the Sophomore year. Graphic Statics of Mechanisms deals with graphic methods of determining the forces acting at all points of a machine and with the efficiency of mechanisms. Heat Engines includes the study of steam boilers, thermodynamics, steam engines, turbines, and gas engines. Engineering Laboratory is given throughout the Senior year.

Important studies in Civil Engineering are included in this course. Strength of Materials is concerned with the theory of beams, columns and shafts, and the method of computing and designing them; the subject includes practical work in the testing laboratory. Hydraulics, including laboratory practice, treats of hydrostatics and theoretical hydraulics, the flow of water through orifices, weirs, pipes and channels, naval hydromechanics and hydraulic motors.

The study of General Metallurgy, Metallurgy of Iron and Steel and Metallurgical Problems is given during the first term

of the Sophomore year. Lectures on Electrochemistry and Electrometallurgy are given during the Senior year.

Advanced studies in Electrical Engineering follow Electric Distribution, Dynamos and Motors, and Electricity and Magnetism of the Sophomore year. Advanced Theory of Electricity and Magnetism is devoted to the theory of electrical units and measurements, ferromagnetism, electromagnetism, and advanced theory of electrostatics, electric oscillations and waves, electron theory and electrolysis. The accompanying laboratory work is devoted to precise electrical measurements and the standardization and calibration of electrical measuring instruments. The Theory of Alternating Currents deals with the problems and methods of measurements which are peculiar to the modern practical applications of alternating currents and with the theory underlying the action of the important types of alternating current machinery and transmission lines. Alternating Current Machinery includes the study of the construction and operation of alternating current generators, motors, transformers and other apparatus.

The subject of Electrical Engineering deals with the application of physical principles to the solution of problems relating to direct and alternating current circuits and apparatus.

Dynamo laboratory work, beginning in the second term of the Sophomore year, is continued for five terms. Instruction is based on a laboratory manual or notes supplemented by individual direction and supervision in the laboratory. The students work individually or in pairs, and make the more important tests on direct and alternating current generators and motors, rotary converters, transformers and other electrical apparatus. Written reports of all tests made, with curves plotted from the observations and discussion of results, are required. Throughout these courses the student is trained not only to perform the experimental work but also to plan and direct it.

Electrical Design, begun in the first term of the Senior year, is pursued throughout the year. It includes the application of electric, magnetic and mechanical principles to the design of various types of electrical apparatus. The instruction is given by recitations, problems and drafting.

Electrical Engineering Seminary continues throughout the Senior year. The work consists of the presentation before the class of papers on assigned topics, supplementing the regular work of the class-room and of reports on thesis work. The Department reading-room is well supplied with the leading electrical periodicals, American and foreign. One of the principal objects of the Seminary work is to encourage the systematic reading of the current engineering journals.

Dynamo Testing, given by lectures and problems, treats of standard and special methods of making tests on dynamo machines, transformers and other electrical apparatus.

Electric Stations takes up the location, design and equipment of stations, the selection of suitable prime movers, generators, switchboards and other apparatus. The cost of generating electric power, and the various systems of determining rates, receive consideration. Under Electric Traction are studied the construction, equipment and operation of different types of electric railways. The recent developments in the application of electric motive power to steam railroad conditions are discussed and the results of tests are analyzed.

The subject of Electric Power Transmission deals with the various elements constituting a transmission system. It includes a study of the generating plant, the transmission line and the receiving systems. Special attention is given to the design, construction and protection of the line. Under the last three subjects are included visits of inspection to electric light and power stations and manufacturing establishments in Bethlehem and elsewhere. Central station tests are made and reports are required.

Electric Communication deals with telephone and telegraph systems, with special emphasis on matters of radio telegraphy and telephony, including theory and operation of vacuum tube circuits. The laboratory work given in connection with this course includes practical experiments and tests on radio apparatus of various types and the operation of sending and receiving sets.

Graduates of this course receive the degree of Electrical Engineer (E.E.).

THE COURSE IN ELECTRICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T
Adv. Algebra	143	(4)	4	8	12
Chemistry .390 or 393		(2)	2	4	6
Chem. Lab. 391or393a		(2)	6	0	6
El. Mechanics	320	(3)	3	5	8
French or German or Spanish	94 / 75 / 111	(3)	3	6	9
English	120	(2)	2	2	4
M.S. & P.E.	470, 500	(2)	4	2	6
			18	24	27	51

SECOND TERM	N	C	R	P	T
P. Anal. Geom.	145	(3)	3	6	9
Qual. Anal.	395	(3)	9	1	10
Stoichiometry	397	(1)	1	1	2
El. Mechanics	321	(3)	3	4	7
Phys. Measure	322	(1)	3	2	5
French or German or Spanish	94 / 75 / 111	(3)	3	5	8
English	122	(2)	2	2	4
M.S. & P.E.	470, 500	(2)	4	2	6
			18	28	23	51

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3)

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T
Cal. & S.A.Geom.	146	(4)	4	8	12
Elec. & Mag.	323	(3)	3	4	7
M. & H. Lab.	324	(1)	2	1	3
Elec. Distribution.	351	(2)	2	6	8
Dr. & El. M. Des.	200	(3)	6	3	9
Metallurgy	247	(3)	3	4	7
M.S. & P.E.	471, 500	(2)	4	2	6
			18	24	28	52

SECOND TERM	N	C	R	P	T
Int. Calculus	147	(4)	4	8	12
Light & Sound.	325	(3)	3	4	7
L., E. & M. Lab.	326	(1)	2	1	3
Dyn. & Mot.	352	(3)	3	6	9
Dyn. Lab.	353	(1)	3	1	4
El. Mach. Des.	203	(3)	3	6	9
Gr. St. of Mech.	206	(2)	4	0	4
M.S. & P.E.	471, 500	(2)	4	2	6
			19	26	28	54

SUMMER TERM: Work in Electrical Shops or Plant, with report, 376, 8 weeks (3)

JUNIOR YEAR

FIRST TERM	N	C	R	P	T
Diff. Equations	148	(1)	1	3	4
Anal. Mech.	149	(2)	2	4	6
Alt. Currents	357	(3)	3	4	7
Dyn. Lab	358	(1)	3	0	3
Elec. Lab.	328	(1)	3	0	3
Adv. Elec. & Mag.	327	(2)	2	4	6
Str. of Mat.	167a	(3)	3	6	9
Str. Mat. Lab.	168	(1)	3	0	3
Heat Eng.	221	(3)	3	6	9
Physical Ed.	500	(1)	2	0	2
			18	25	27	52

SECOND TERM	N	C	R	P	T
Alt. Cur.	359	(2)	2	4	6
Elec. Engr.	360	(3)	3	6	9
Dyn. Test.	364	(1)	3	0	3
Dyn. Lab.	362	(1)	3	1	4
Elec. Lab.	329	(1)	3	1	4
Hydraulics	170a	(2)	2	4	6
Hyd. Lab.	171	(1)	3	0	3
Heat Eng.	222	(3)	3	6	9
English	127	(3)	3	3	6
Physical Ed.	500	(1)	2	0	2
			18	27	25	52

SUMMER TERM: Work in Electrical Shops or Plant, with report, 376, 8 weeks (3)

SENIOR YEAR

FIRST TERM	N	C	R	P	T
Alt. Cur. Mach.	363	(4)	4	6	10
Dyn. Testing	365	(1)	1	1	2
Dyn. Lab.	366	(3)	6	3	9
Elec. Design	367	(2)	3	3	6
Elec. Stations	368	(2)	2	4	6
El. Chem. & Met.	254	(2)	2	3	5
Engr. Lab.	220	(1)	3	0	3
Elec. Seminary	369	(1)	2	1	3
Bus. Engr.	30a	(3)	3	3	6
Physical Ed.	500	(1)	2	0	2
			20	28	24	52

SECOND TERM	N	C	R	P	T
Elec. Traction / or Elec. Com.	371 / 378	(3)	3	5	8
Elec. Power Tr.	372	(3)	3	5	8
Elec. Design.	370	(2)	2	3	5
Dyn. Lab.	374	(2)	6	2	8
Elec. Seminary	373	(1)	2	1	3
Engr. Lab.	226	(1)	3	0	3
Bus. Engr.	30a	(3)	3	3	6
Thesis	377	(3)	8	1	9
Physical Ed.	500	(1)	2	0	2
			19	32	20	52

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

THE COURSE IN CHEMISTRY

The requirements for admission to the Course in Chemistry are given on page 19.

This course, leading to the degree of Bachelor of Science in Chemistry, offers an education primarily in chemistry, with some training in related sciences. The modern conception of an education in chemistry includes a simultaneous, thorough study of physics and mathematics. In addition to these so-called physical sciences, other studies, planned to develop and aid the thought-processes and culture of the student, are embodied in the course. It is believed by many practicing chemists and chemical engineers that an undergraduate course embracing a liberal allotment of study in the humanities is the best preparation for a successful career. Aside from preparation for the life of a professional chemist, it is well adapted for teachers of chemistry and as a course preliminary to the study of medicine.

This course and the Course in Chemical Engineering are both given under the direction of the Department of Chemistry, and facility is offered for changing from either course to the other at the end of either term of the Freshman year. The entrance subjects required are the same in both courses (see page 19), and the tuition and laboratory costs are practically the same. Subjects with the same title in the tabulated curricula (see pages 68 and 73) are given to students in both courses simultaneously and under the same teachers, and are equal in content. Details of chemistry subjects are described in the course in Chemical Engineering.

The study of English is carried through two full years of this course, beginning in the Freshman year and being resumed in the Junior year when the student has a more mature appreciation of literary values and of the necessity for clear and forceful expression in speech and writing. French and German receive considerably more attention in the course in Chemistry, than in the course in Chemical Engineering, both as language tools for the working chemist and in their cultural aspects. Students who enter the University with French continue French through the Freshman year, and take up German through the Sophomore and Junior years. Those who offer German as an entrance subject continue German through the Freshman and Sophomore years and study French through

the Junior year. Students who offer Spanish for entrance take German through the Freshman and Sophomore years, and French through the Junior year.

The course in Bacteriology of the Senior year is given in the Department of Biology. A short course in Industrial Mineralogy accompanies the course in Assaying. Geology follows in the second term of the Junior year.

Economics throughout the Junior year and Modern European History through the Senior year are given by the Department of History and Economics. The same department supervises the Summer Reading in Economics, embracing such subjects as origins of industry and their relations to science, the economic import of inventions, industrial management, business law and custom and contracts. The topics for Summer Reading are also correlated in the lectures under the heading Economics, mentioned above. It is believed that this course of reading and study under expert guidance will inculcate an appreciation of the profit and pleasure to be derived from a continued interest in history and economics.

Applications of the science of chemistry and the science of physics to industrial chemistry and to chemical engineering are carried in the Senior year under the courses called Industrial Chemistry and Industrial Chemistry Laboratory. This covers a thorough-going description of numerous manufacturing processes and includes the necessary elements of chemical engineering. The industrial development of chemistry in the manufacture of metals is the subject of the various courses in Metallurgy and Electrometallurgy of the upper years. Here again the engineering features of many procedures are explained and receive critical study.

In order to acquaint the student with factory methods and personnel, a required summer term of work in factory or laboratory is set for the vacation following the Junior year. Young men of exceptional ability and ambition are encouraged to enroll in subjects given in the University not listed in the Course in Chemistry, subject to Faculty rules.

The foregoing course will serve as an excellent preparation for graduate study; students who desire to go forward to the Master's Degree (M.S.) will find information on page 137 of this Register.

THE COURSE IN CHEMISTRY

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Adv. Algebra	143	(4)	4	8	12	P. Anal. Geom.	145	(3)	3	6	9
Chemistry	390 or 393	(2)	2	4	6	Chemistry	394	(1)	1	1	2
Chem. Lab.	391or393a	(2)	6	0	6	Qual. Anal.	395	(3)	9	0	9
El. Mechanics	320	(3)	3	5	8	Qual. An. Conf.	396	(1)	1	2	3
French or German	94 } 72 or 76	(3)	3	6	9	Stoichiometry	397	(1)	1	1	2
English	120	(2)	2	2	4	El. Mechanics	321	(3)	3	4	7
M.S. & P.E.	470, 500	(2)	4	2	6	Phys. Measure	322	(1)	3	2	5
						French or German	94 } 72 or 76	(3)	3	5	8
			18	24	27	51	M.S. & P.E.	470, 500	(2)	4	2	6
									18	28	23	51

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3); Summer reading in Economics, 30 (1)

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Cal. & S.A. Geom.	146	(4)	4	8	12	Int. Calculus	147	(4)	4	8	12
Adv. Chem.	398	(3)	3	3	6	Adv. Chem.	399	(3)	3	6	9
Quant. Anal.	400	(3)	9	0	9	Quant. Anal.	404	(2)	6	0	6
Quant. An. Conf.	402	(1)	1	2	3	Quant. An. Conf.	405	(2)	2	1	3
Elec. & Mag.	323	(3)	3	4	7	Light & Sound	325	(3)	3	4	7
M. & H. Lab.	324	(1)	2	1	3	L., E. & M. Lab.	326	(1)	2	1	3
German	72, 76 or 78	(3)	3	5	8	German	72, 76 or 79	(3)	3	5	8
M.S. & P.E.	471, 500	(2)	4	2	6	M.S. & P.E.	471, 500	(2)	4	2	6
			20	29	25	54			20	27	27	54

SUMMER TERM: Assaying and Industrial Mineralogy, 4 weeks, 414 (3); Summer reading in Economics, 30 (1)

JUNIOR YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Quant. Anal.	406	(2)	6	0	6	Org. Chem.	410	(4)	4	5	9
Quant. An. Conf.	407	(2)	2	2	4	Org. Chem. Lab.	411	(3)	9	0	9
Org. Chem.	408	(3)	3	3	6	I.& S.& Probs.	245,246	(3)	3	4	7
Org. Chem. Lab.	409	(2)	6	0	6	Gen. Geol.	268	(2)	2	3	5
G.Met.&Probs.	243,244	(3)	3	4	7	Economics	17	(3)	3	3	6
Economics	16	(3)	3	3	6	French or German	90 } 76 or 79	(3)	3	5	8
French or German	90 } 76 or 78	(3)	3	5	8	English	127	(3)	3	4	7
English	123	(3)	3	4	7	Physical Ed.	500	(1)	2	0	2
Physical Ed.	500	(1)	2	0	2				22	29	24	53
			22	31	21	52						

SUMMER TERM: Work in Industrial Shop or Laboratory (3); Summer reading in Economics, 30 (1)

SENIOR YEAR

FIRST TERM	N	C	R	P	T	SECOND TERM	N	C	R	P	T
Phys. Chem.	419	(3)	3	3	6	Phys. Chem.	421	(2)	2	3	5
Phys. Chem. Lab.	420	(1)	3	0	3	Phys. Chem. Lab.	422	(1)	3	0	3
Ind. Chem. Lab.	412	(3)	9	2	11	Ind. Chem.	415	(3)	3	3	6
Research Chem.	423	(3)	3	6	9	Research Lab.	424	(2)	6	0	6
N.F.Met.&Prob.	248,249	(3)	3	4	7	Ind. Chem. An.	416	(3)	9	0	9
Bacteriology	296	(2)	3	3	6	Ind. An. Conf.	417	(1)	1	1	2
El. Chem.	252	(1)	1	2	3	San. Chem. Lab.	418	(1)	3	0	3
History	41	(3)	3	3	6	N. F. Met.	250	(2)	2	2	4
Physical Ed.	500	(1)	2	0	2	El. Met.	253	(1)	1	2	3
						Hist. of Chem.	425	(1)	1	1	2
						History	42	(3)	3	3	6
						Physical Ed.	500	(1)	2	0	2
			20	30	23	53			21	36	15	51

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

THE COURSE IN CHEMICAL ENGINEERING

The requirements for admission to the Course in Chemical Engineering are given on page 19.

This course of study is designed to prepare the student for the profession of chemical engineering in the construction, control and management of manufacturing establishments which utilize principles of chemistry and its allied arts. Aside from the primary requirement of chemistry, the modern development of the chemical engineer enforces a thorough knowledge of physics and mathematics, together with sound understanding of such fundamentals in mechanical and electrical engineering as will make him a discriminating research and operating engineer.

The following descriptions of subjects given in the Department of Chemistry apply as well to these subjects in the Course in Chemistry. (See page 66.)

Elementary Chemistry, begun in the Freshman year, in lectures with demonstrations, text-books and recitations, is supplemented by experiments in the laboratory which develop manipulative skill and make careful observation habitual. An alternate course, less elementary in both class-room and laboratory, is given to entering students who have had a considerable training in elementary chemistry. (See page 30.)

After this preliminary view of the elements of chemistry, there is developed that deeper insight into the changes of matter which is the particular province of general chemistry. In Advanced Chemistry of the first term in the Sophomore year particular attention is paid to the theories and modern concepts of chemistry, including solution, equilibrium and energy relations of molecules and of atoms, radio-activity, etc.,—a kind of junior physical-chemistry of the greatest, everyday importance in chemical engineering. Continued through the second term, this subject covers a moderately advanced study of chemical substances, their preparation and properties, together with elementary consideration of phase rule and of such general applications as the relations underlying desirable properties in alloys, iron and steel, etc.

Organic Chemistry, taught during the entire Junior year, familiarizes the student with the simple compounds of carbon, and acquaints him with the usefulness of this branch of chemistry in science, in the chemistry of animal and plant life, and

in the manufacture of such chemical products as dyes, drugs and medicines, oils, fats, waxes, and many others.

A course of lectures of two hours per week on Advanced Organic Chemistry is offered in the first half of the Senior year to students who have shown marked ability in the Organic Chemistry and Organic Chemistry Laboratory of the Junior year. This course is available for credit to graduate students who have completed a strong undergraduate course.

Introduction to the chemical analysis of substances is begun through Qualitative Analysis in the second term of the Freshman year. This is a laboratory course, proceeding from the recognition of individual substances to the analysis of more complex solutions and solids. Lectures and recitations elucidate the facts and theories underlying analytical chemistry. The simpler mathematical relations of chemical processes are reviewed under Stoichiometry and are illustrated through many problems solved by the student. Quantitative Chemical Analysis by gravimetric, volumetric and electrolytic methods follows through the Sophomore year and the first term of the Junior year, and takes up the analysis of ores, fuels, metallurgical products, commercial chemicals and by-products. Frequent class-room conferences accompany the laboratory work and consider the calculations involved and the scientific foundations of quantitative analysis. The analysis of industrial organic substances and of food-stuffs, drinking and boiler waters is placed in the final term of the Senior year, when the student has a better foundation in increasing experience and a broader outlook toward the important significance of Industrial Chemistry. At this stage, too, is placed the sampling and analysis of illuminating and heating gas, flue gases and other special gases.

Fire-assaying of ores and of gold and silver bullion is taught in the summer term after the Sophomore year when continuous attention throughout the day can be given to muffles and furnaces. The practice in Assaying is accompanied by extensive consideration of the calculations and theories involved in the production of mixtures favorable for the work in hand. A course in Industrial Mineralogy is a part of this summer work, and leads to familiarity with about seventy-five minerals of commercial importance. These minerals are studied in their crystalline forms, also in the forms in which they often present

themselves for final utilization by the chemical engineer.

The laboratory methods of Physical Chemistry and the systematic, deeper study of generalizations of chemistry learned in the Sophomore year are reserved for the Senior year under Physical Chemistry. Interrelations of the fundamentals of matter and energy are developed under such cognate headings as two-phase and multiphase systems, thermodynamics, gas reactions, mass action, electrochemistry, colloid chemistry, etc. Attention is given to the usefulness of Physical Chemistry in the solution of manufacturing problems in Chemical Engineering.

Intensive instruction in the application of factory methods in Chemical Engineering is likewise placed in the Senior year and is grouped under Industrial Chemistry Laboratory and Industrial Chemistry. The processes reviewed are varied; such as transportation of gases, liquids and solids; grinding, pulverizing; mechanical, hydraulic and pneumatic separation; evaporation; distillation; filter pressing; centrifuging; autoclaving. Characteristics and adaptability of engineering materials used in apparatus and machines receive full discussion. Selected industries are investigated and explained. Familiarity with manufacture in its scientific and economic aspects is promoted in the special laboratory fitted with industrial apparatus, the student finally submitting full working specifications for a plant designed for the preparation of some industrial product, together with estimates of cost of raw material and cost of conversion into finished product. Lehigh University is fortunately situated in a district abounding in business enterprises which involve chemical engineering and visits are made to these plants and to factories in the nearby cities of Philadelphia and New York.

In Research Chemistry of the Senior year every student is required to solve a novel problem having a scientific basis and is expected to demonstrate some ability as an independent research worker. The research involves an exhaustive search for and study of the literature bearing on the subject in the University Library, and includes the patent literature. A short course in History of Chemistry, with individual reading of significant records, co-ordinates the past progress of the science and leads to a nobler pride and an enhanced initiative in the profession which the graduate enters.

Metallurgy and related subjects are taken in the Department

of Metallurgy. These cover an extensive training in the principles and methods particularly applied to the recovery of metals from their ores, and the manufacture and properties of the industrial products, iron, steel, copper, zinc, lead, nickel, aluminium, mercury, gold and silver. Drawing is under the direction of the Department of Mining Engineering. Instruction in mechanical engineering, so important to the chemical engineer, is given by the Mechanical Engineering Department. Mechanical Engineering is developed in Heat Engines of the Junior year, and in the Engineering Laboratory of the summer term following the Junior year, with a continuation of Engineering Laboratory in the Senior year. Many of the problems and innovations of Chemical Engineering demand a more intimate knowledge of the principles and practice of Electrical Engineering than is given in the general course in Physics; this is provided for in the Junior year under Dynamos and Motors and Alternating Currents, with their laboratory adjuncts, in the Department of Electrical Engineering. A comprehension of the scope and general methods of Geology and Bacteriology is attained in short courses in these subjects. Bacteriology is a lecture and laboratory course, and a working knowledge of bacteriological methods as applied to water and some industrial products is achieved. The study of German, a necessary tool in current chemistry, is carried by all students in the Freshman year.

An approach to the affairs of men and the problems of business and civilization is carried in some period of all four years, and is under the direction of the Head of the College of Business Administration. The full course of lectures in Economics as given in the University is placed in the Junior year. Related reading is specified as summer work, and examination in this requirement is held on the first Saturday following the opening of the first term. Summer reading comprises such matter as origins of industry and their relation to science, industrial management, business law and custom and contracts.

A scientific society is attached to the Department, with a membership of teachers and students, for the presentation of papers, discussion of current journals, and the entertainment of speakers of note in the profession of chemical engineering.

The degree granted on completion of the course is Chemical Engineer (Ch.E.).

THE COURSE IN CHEMICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T
Adv. Algebra	143	(4)	4	8	12
Chemistry	390 or 393	(2)	2	4	6
Chem. Lab.	391or393a	(2)	6	0	6
El. Mechanics	320	(3)	3	5	8
German	72 or 76	(3)	3	6	9
English	120	(2)	2	2	4
M.S. & P.E.	470, 500	(2)	4	2	6
		18	24	27	51

SECOND TERM	N	C	R	P	T
P. Anal. Geom.	145	(3)	3	6	9
Chemistry	394	(1)	1	1	2
Qual. Anal.	395	(3)	9	0	9
Qual. An. Conf.	396	(1)	1	2	3
Stoichiometry	397	(1)	1	1	2
El. Mechanics	321	(3)	3	4	7
Phys. Measure	322	(1)	3	2	5
German	72 or 76	(3)	3	5	8
M.S. & P.E.	470, 500	(2)	4	2	6
		18	28	23	51

SUMMER TERM: R. O. T. C. Camp, with report, 470a, 6 weeks (3);
Summer reading in Economics, 30 (1)

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T
Cal. & S.A.Geom.	146	(4)	4	8	12
Adv. Chem.	398	(3)	3	3	6
Quant. Anal	400	(3)	9	0	9
Quant. An. Con.	402	(2)	2	2	4
Elec. & Mag.	323	(3)	3	4	7
M. & H. Lab.	324	(1)	2	1	3
Drawing	300	(1)	3	0	3
English or German	123} 73}	(2)	2	2	4
M.S. & P.E.	471, 500	(2)	4	2	6
		21	32	22	54

SECOND TERM	N	C	R	P	T
Int. Calculus	147	(4)	4	8	12
Adv. Chem.	399	(3)	3	6	9
Quant. Anal.	404	(3)	9	0	9
Quant. An. Conf.	405	(2)	2	3	5
Light & Sound	325	(3)	3	4	7
L., E. & M. Lab.	326	(1)	2	1	3
Drawing	300	(1)	3	0	3
M.S. & P.E.	471, 500	(2)	4	2	6
		19	30	24	54

SUMMER TERM: Assaying and Industrial Mineralogy, 4 weeks, 414 (3);
Summer reading in Economics, 30 (1)

JUNIOR YEAR

FIRST TERM	N	C	R	P	T
Quant. Anal.	406	(2)	6	0	6
Quant. An. Conf.	407	(1)	1	1	2
Org. Chem.	408	(3)	3	2	5
Org. Chem. Lab.	409	(2)	5	0	5
Dyn. & Mot.	354	(2)	2	4	6
Dyn. Lab.	355	(1)	3	1	4
G.Met.&Probs.	243,244	(3)	3	4	7
Heat Eng.	223	(3)	3	6	9
Economics	16	(3)	3	3	6
Physical Ed.	500	(1)	2	0	2
		21	31	21	52

SECOND TERM	N	C	R	P	T
Org. Chem.	410	(4)	4	5	9
Org. Chem. Lab.	411	(3)	9	0	9
I.& S.& Probs.	245,246	(3)	3	4	7
Alt. Cur.	375	(2)	2	4	6
Dyn. Lab.	356	(1)	3	1	4
Heat Eng.	224	(3)	3	6	9
Economics	17	(3)	3	3	6
Physical Ed.	500	(1)	2	0	2
		20	29	23	52

SUMMER TERM: Engineering Laboratory, 4 weeks, 225 (3);
Summer reading in Economics, 30 (1)

SENIOR YEAR

FIRST TERM	N	C	R	P	T
Phys. Chem.	419	(3)	3	3	6
Phys. Chem. Lab.	420	(1)	3	0	3
Ind. Chem. Lab.	412	(3)	9	2	11
Research Chem.	423	(2)	2	4	6
N.F.Met.&Prob.	248,249	(3)	3	4	7
Engr. Lab.	220	(1)	3	0	3
Bacteriology	296	(2)	3	3	6
El. Chem.	252	(1)	1	2	3
El. Chem. Lab.	255	(1)	2	1	3
English	137	(1)	2	0	2
Physical Ed.	500	(1)	2	0	2
		19	33	19	52

SECOND TERM	N	C	R	P	T
Phys. Chem.	421	(2)	2	3	5
Phys. Chem. Lab.	422	(1)	3	0	3
Ind. Chem.	415	(3)	3	3	6
Research Lab.	424	(2)	5	0	5
Ind. Chem. An.	416	(3)	9	0	9
Ind. An. Conf.	417	(1)	1	1	2
San. Chem. Lab.	418	(1)	3	0	3
Hist. of Chem.	425	(1)	1	1	2
N. F. Met.	250	(2)	2	2	4
El. Met.	253	(1)	1	2	3
Engr. Lab.	226	(1)	3	0	3
Gen. Geol.	268	(2)	2	3	5
Physical Ed.	500	(1)	2	0	2
		21	37	15	52

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

THE COURSE IN SHIP CONSTRUCTION AND MARINE TRANSPORTATION

The requirements for admission to the Course in Ship Construction and Marine Transportation are given on page 19.

The purpose of this course is to prepare men to engage in the design, construction and operation of ships, and to enter the field of marine transportation. The course is a combination of engineering and economics preceded by the fundamental subjects common to engineering courses: chemistry, modern languages, physics and mathematics. Combining, as it does, engineering training with studies in economics and business administration, such a course offers great advantages. It has been planned to develop a class of men, who in addition to a knowledge of conditions governing ocean and inland water transportation, will have a command of the technical, economic, and financial problems of ship design, construction and operation.

The first and second years are devoted largely to physics, modern languages, chemistry, engineering drawing, and mathematics, all of which afford necessary preparation for the technical work in later years.

The second year schedule, although largely concerned with science, embraces some preliminary work in engineering and economics. There is a detailed study of ship construction, including lectures and class room work covering the main features of ship construction, and also work in the drawing room where drawings of ship construction are worked up by the student. In the secord term the student fairs up a set of ship's lines. Both the transverse and longitudinal types of construction are given full treatment in this course.

The Junior year schedule includes these fundamental engineering subjects: Strength of Materials, Hydraulics, Naval Architecture, Steam Engineering, Marine Engineering, and Astronomy and Navigation. Class room work in most of the subjects is supplemented by exercises in the laboratories. In the first term of the third year a study is made of the theory of heat engineering and thermodynamics. This course is followed in the second term by a study of marine engineering

with special emphasis on the types of propelling machinery, layout of the marine power plant and economic problems in marine engineering.

In the Senior year the student takes up the study of Ship Design, Marine Engines and Turbines, Structural Steel Design, Electrical Engineering, Economics, and Marine Transportation. For those who desire further work in foreign languages, an opportunity is given in the Senior year for the study of Spanish.

An important feature of the Lehigh Course in Ship Construction and Marine Transportation is the large amount of time devoted to the study of economics and allied subjects. To arouse the student's interest and to fit him for work in marine transportation and foreign trade, instruction in Economics and Economic Geography is given in the Sophomore year, followed by Accounting and Finance in the Junior year, and by Foreign Trade, Marine Insurance and Admiralty Law in the Senior year.

Surveying is given during four weeks of the summer term immediately following the close of the Freshman year.

Students are required to do summer work in shipyards and on shipboard, and the department co-operates in finding positions for them. The summer following the Sophomore year is spent in a shipyard. This brings the student into direct contact with practical ship construction and shipyard practices, so that he unconsciously acquires a knowledge of proportions and dimensions of engineering structures. The summer following the Junior year is spent at sea so that the student may observe the action of a ship at sea, and study the operation of the ship's power plant.

A pamphlet, giving further details, may be obtained by addressing the Registrar.

Graduates of this course receive the degree of Naval Engineer (N.E.).

THE COURSE IN SHIP CONSTRUCTION AND MARINE TRANSPORTATION

FRESHMAN YEAR

FIRST TERM	N	C	R	P	T
Adv. Algebra	143	(4)	4	8	12
Chemistry .390 or 393		(2)	2	4	6
Chem. Lab. 391or393a		(2)	6	0	6
El. Mechanics	320	(3)	3	5	8
French / or German / or Spanish	94 / 75 / 111	(3)	3	6	9
English	120	(2)	2	2	4
M.S. & P.E.	470, 500	(2)	4	2	6
		18	24	27	51

SECOND TERM	N	C	R	P	T
P. Anal. Geom.	145	(3)	3	6	9
Qual. Anal.	395	(2)	6	1	7
Stoichiometry	397	(1)	1	1	2
El. Mechanics	321	(3)	3	4	7
Phys. Measure.	322	(1)	3	2	5
French / or German / or Spanish	94 / 75 / 111	(3)	3	5	8
English	122	(2)	2	2	4
Drawing	162	(1)	3	0	3
M.S. & P.E.	470, 500	(2)	4	2	6
		18	28	23	51

SUMMER TERM: Land and Topographic Surveying, 165, 3 weeks (3)

SOPHOMORE YEAR

FIRST TERM	N	C	R	P	T
Cal. & S.A.Geom.	146	(4)	4	8	12
Elec. & Mag.	323	(3)	3	4	7
M. & H. Lab.	324	(1)	2	1	3
Metallurgy	247	(3)	3	4	7
Engr. Drawing	163	(3)	7	1	8
Ship Constr.	450	(2)	4	1	5
Economics	16	(3)	3	3	6
M.S. & P.E.	471, 500	(2)	4	2	6
		21	30	24	54

SECOND TERM	N	C	R	P	T
Int. Calculus	147	(4)	4	8	12
Light & Sound	325	(3)	3	4	7
L. E. & M. Lab.	326	(1)	2	1	3
Econ. Geog.	35	(3)	3	6	9
Ship Constr.	451	(4)	9	2	11
Economics	17	(3)	3	3	6
M.S. & P.E.	471, 500	(2)	4	2	6
		20	28	26	54

SUMMER TERM: Work in Shipyard on Hull Construction, with report, 458, 8 weeks (3)

JUNIOR YEAR

FIRST TERM	N	C	R	P	T
Str. of Mat.	167	(4)	4	8	12
Str. Mat. Lab.	168	(1)	3	0	3
Naval Arch.	452	(3)	3	5	8
Astronomy	150	(3)	3	6	9
Heat Engr.	218	(3)	3	6	9
Accounting	20	(3)	3	6	9
Physical Ed.	500	(1)	2	0	2
		18	21	31	52

SECOND TERM	N	C	R	P	T
Hydraulics	170	(3)	3	6	9
Hyd. Lab.	171	(1)	3	0	3
Naval Arch.	453	(4)	4	8	12
Navigation	153	(2)	2	6	8
Marine Engr.	454	(4)	4	8	12
Finance	18	(2)	2	4	6
Physical Ed.	500	(1)	2	0	2
		17	20	32	52

SUMMER TERM: At Sea, with report, 458, 8 weeks (3)

SENIOR YEAR

FIRST TERM	N	C	R	P	T
Ship Design	455	(3)	6	3	9
Marine Engs.	219	(3)	6	3	9
Str. Steel Des.	176	(4)	6	6	12
Engr. Lab.	220	(1)	3	0	3
Admiralty Law / or Spanish	32a / 110	(2)	2	4	6
Dyn. & Mot.	354	(2)	2	4	6
Dyn. Lab.	355	(1)	3	1	4
Physical Ed.	500	(1)	2	0	2
		17	27	24	51

SECOND TERM	N	C	R	P	T
Ship Design	456	(3)	6	3	9
Ship Operation	459	(2)	2	4	6
Term. Facilities.	457	(2)	2	4	6
Engr. Lab.	226	(1)	3	0	3
Foreign Trade	29	(3)	3	6	9
English / or Spanish	127 / 110	(3)	3	3	6
Alt. Cur.	375	(2)	2	4	6
Dyn. Lab.	356	(1)	3	1	4
Physical Ed.	500	(1)	2	0	2
		18	26	25	51

Figures under letters above indicate the following: N, course numbers in Register; C, number of credit hours a week; R, number of clock hours a week in class; P, average number of clock hours a week in outside work and preparation; T, total number of hours a week.

LIST OF STUDIES

Following is a complete list of studies offered by the University in its various courses. The number of exercises a week in each subject is indicated by the figures in parentheses. Two hours of drawing, three of work in the laboratory or three of practice in the field are regarded as equivalent to a recitation or lecture of one hour's duration.

UNDERGRADUATE COURSES

PSYCHOLOGY

PROFESSOR HUGHES

1. General Psychology. Woodworth. For B.A. students. Recitations and demonstrations. First term (3).

2. Educational Psychology. Individual differences; analysis of mental traits; learning and memory; how to study; transfer of training; motivation and character building; the psychology of specific activities, as of speech, writing, arithmetic, sport, art, religion. Assigned readings; quantitative studies; lectures and discussions. For B.A. students. Preparation required: 1. Second term (3).

3. Advanced Educational Psychology. Practice in administering individual and group tests. Study of administrative applications. Study of classical investigations in the general field covered by course 2, with some first-hand investigation or experiment. Preparation required 2. First term (3).

4. Elements of Clinical Psychology. Primarily for seniors in the pre-medical course. Abnormalities and diseases of the mind. The psychology of the emotions and of temperament. Individual studies, with use of intelligence and temperament tests. Psychotherapy. Mental Hygiene. Watson's *Psychology from the Standpoint of a Behaviorist.* Current magazine literature. Excursions to hospitals and clinics. Preparation required: 2. Second term (3).

5. Principles of Psychology. For B.S. students. Woodworth. Recitations and demonstrations. First term (2).

6. Economic Psychology. For B.S. students. Woodworth, continued. Problems of personnel, of motivation in industry,

and of industrial training. Assigned readings. Preparation required: 1 or 5. Second term (2).

7. Experimental Psychology. A course for Seniors who wish to conduct individual studies in some field of psychological experiment. Preparation required: 2 or 6. First or second term (1).

PHILOSOPHY

PROFESSOR HUGHES

8. History of Philosophy. Ancient. A rather careful study of Plato's *Republic*. More's *Platonism*. Lectures and readings in the great philosophical tradition. First term (2).

9. History of Philosophy. Modern. The rise of modern science, contrasted with Greek thought. Spinoza's *Ethics*. Tendencies in Modern Thought. Perry's *Present Conflict of Ideals*. Second term (2).

10. Scientific Method. Historical survey of remarkable discoveries and inventions. The progress of the organization of knowledge. Idols of the tribe. Formal principles of proof. Libby's *Outline of the History of Science*, and Jevon's *Logic*. Second term (3).

EDUCATION

ASSISTANT PROFESSOR DROWN, PROFESSOR HUGHES

In this connection the student should study the statement on pages 38 to 40, concerning preparation for teaching.

11. Introduction to Teaching. Adjusting pupils' school and social interests. Introduction of pupil to effective methods of study. Subject matter and method related to technique and routine. Dewey, Earhart, Holley. First term (3).

12. History of Education. The advance of civilization and culture and the parallel progress of educational theory and practice. (1) Evolution of subject matter; the liberal arts, letters, science, social sciences, the vernacular, vocational and fine arts. (2) Evolution of educational institutions; the university, the college, the secondary and elementary types, the rise of national and state school systems. (3) Educational leaders; how they reflected their times, and their contributions to educational philosophy and practice. Cubberley's *History of Education* and Readings. Second term (3).

13. Principles of High School Teaching. Character and qualifications essential to the high school teacher. The character of the high school student. Types of class exercises in the high school. Essential factors and devices of high school methods; lesson planning and the assignment; the question; note books and reports; reviews and examinations; the laboratory; experimentation and demonstration; the library and source material; problems and projects. Exercises in lesson planning, readings and observations. First term (3).

14. School Efficiency. State and local school systems. Organization of the school. Organization and routine of the class room; management, discipline, supplies, forms, reports; markings, grading, testing, promotion. The external and administrative aspects of teaching. Second term (3).

15. Problems of Secondary Education. Secondary education; its historical and comparative aspects; study of German, French, English and American secondary schools. The social background of American secondary education. The aims, values and functions of secondary education; analysis of each of the secondary subjects in terms of the same. The personnel of the secondary school. Problems arising out of adolescence; problems arising out of individual differences; problems arising out of economic and social conditions. Articulation with elementary and higher education; the Junior High School; the Junior College; accrediting and examination systems. Programs of studies; required and elective subjects. Administrative problems. Extra curricula activities; the teaching staff; the plant and its equipment; costs and finance. Second term (3).

16. Practice Teaching. This work is for the most part carried on in the Bethlehem High Schools. The Junior and Senior High Schools of Allentown and Easton also are observed. The work is divided into three approximately equal parts:

1. Observation and report with conference.
2. Apprentice work, involving participation in the routine work of the class, conduct of study periods and correcting of papers.

3. Actual conduct of class work, after careful study of lesson plans, followed by systematic criticism by assisting teacher and by the professors of the department.

Junior and Senior years, for students in Education. (2) to (6).

SPECIAL METHOD. See courses 54, 83, 93, 339.

EDUCATIONAL PSYCHOLOGY. See courses 2 and 3.

BUSINESS ADMINISTRATION

PROFESSORS STEWART AND FOX, ASSOCIATE PROFESSOR BICKLEY, ASSISTANT PROFESSORS CURTIS AND BROWN

ECONOMICS

16. ECONOMICS. A study of the elementary principles of political economy. Lectures and required reading in selected works. First term (3).

17. ECONOMICS. Practical economic problems; taxation, transportation, finance, labor, trusts, and monopolies. Second term (3).

18. BUSINESS FINANCE. A study of the financial needs of the different forms of industrial organization, including individual proprietorship, partnership, corporation, and holding company, together with various means of meeting these needs. Second term (2).

18a. CORPORATION FINANCE. A study of the means of financing a corporation, including the sale of commercial paper, common and preferred stock, debenture and mortgage bonds, promotion of new corporations, underwriting, re-organization and receivership. First and second terms (3).

19. PUBLIC FINANCE. Government expenditures and their relation to the functions of government and to social, political and industrial conditions; formulation of budgets; nature and employment of public credit; origin and growth of public debts; revenues from various sources, with reference both to the theory and to the practice of various nations. First and second terms (3).

20. ACCOUNTING THEORY AND PRACTICE. A study of the fundamental principles of accounting with sufficient practice work to illustrate these principles. Theories of debit and credit; single

and double entry; construction of accounts; special books; distinction between capital and revenue and the problem involved; construction and analysis of financial statements; equity accounts; valuation of assets; methods and problems of depreciation. The economic aspects of accounting emphasized. First and second terms (3).

21. Corporation Accounting. (Elective, Junior year.) The application of accounting principles to corporations, corporation accounts and records. The voucher system; construction and analysis of corporate statements and reports; assets of corporations and their valuation; capital stock and the stock books; bonds and other forms of indebtedness; distribution of profits; handling surplus and reserves; sinking and other funds; liquidation of a corporation; combinations and consolidations; branch house accounting. Considerable practice work given during the second term. The problems are selected largely from examinations for Certified Public Accountancy. First and second terms (3).

21a. Auditing. (Elective, Senior year.) Procedure in conducting an audit; detection of errors and defalcations; financial conditions of a business as revealed by the accounts and other sources of information. The social responsibilities of auditing. First term (3).

21b. Cost Accounting. (Elective, Senior year.) The various systems of manufacturing accounts for different types of manufacturing enterprises; choice of methods to meet peculiar needs; installing cost systems; forms and records; manufacturing accounts as an aid to and as a check on production efficiency; preparation of reports for executives. Second term (3).

22. Transportation. Development of transportation facilities. Consideration, from the administrative viewpoint, of railways and waterways as factors in the social and industrial development of the United States. The organization of railways, considering charters and franchises, capital stock, directors and stockholders. The administration and operation of railways, considering the activities of the various departments,—transportation, traffic, executive, financial, and legal. Relations

between railroads and their employees. Public regulation and control of transportation facilities. First and second terms (2).

23. Labor Legislation and Administration. Labor problems confronting the employer and the more successful methods of meeting them and avoiding legal disputes. The legal status of unions and strikes. Protection of the employer's interests. Employer's Liability and Workmen's Compensation Acts. First and second terms (3).

24. Development of Economic Thought. The rise and development of economic systems and economic thought; the scope and method of political economy. Patten's *Development of English Thought* and the works on political economy of Keynes, Cohn and Ingram. First and second terms (3).

25. Investments. A comparative study of investment values (including bonds, stocks, notes, and mortgages) and the conditions affecting the investment market; with the emphasis on the securities of corporations as investments. First and second terms (3).

26. Statistics. Statistical method and applied statistics. Practice in the handling and especially in the interpretation of statistics. As much research as possible carried on. First and second terms (3).

27. Banking and Currency. A study of the banking system of the United States, comparing it with those of the important European states, together with a study of the currency and currency problems of this country. Special emphasis laid upon the Federal Reserve Act, foreign exchange, and factors affecting the money market. First and second terms (3).

28. Foreign Exchange. Foreign monies and exchange ratios, financing of exports and imports, factors determining exchange rates, statistical studies in the field of foreign exchange, instruments and forms used in foreign trade. First term (3).

29. Foreign Trade and Marine Insurance. An historical and statistical study of international trade; the organization of steamship lines; combines, export associations, and rate agreements; line and charter traffic and trade routes. A study of steamship ports and the influence of the hinterland with special attention to the relations of navigation or inland waterways and railway transportation to ocean commerce. Also a

study of the special methods necessary for successful trading with certain undeveloped but progressing nations. Principles of insurance and the peculiarities of marine risks and policies. Second term (3).

30. Summer Reading in Economics. Assignments for summer of 1923. Freshman: Resources. Van Hise's *The Conservation of Natural Resources.* Sophomore: Industrial Society. Marshall's *Readings in Industrial Society.* Junior: Industrial Administration. Webb's *The Works Manager Today;* Gantt's *Organizing for Work;* Tead's *Instincts in Industry.* (1)

30a. Business Engineering. The organization and financing of business associations, economics, accounting, finance. For Senior students in Engineering. First and second terms (3).

LAW AND POLITICAL SCIENCE

31. Elements of Business Law. The principles of contract; formation of contracts; operation and discharge of contracts. First term (2).

32. Elements of Business Law. Principal and agent; master and servant; sales of goods; negotiable instruments; business associations; partnerships and corporations. Second term (2).

32a. Admiralty and Maritime Law. Study of the principles and rules which regulate the conduct, the business and the property in matters of admiralty and maritime character. First term (2).

33. Constitutional Law. The constitutional framework and the practical operation of the Federal and State governments. The relation of government to the business and social interests of the people. Interpretation of the Constitution by the various departments of the government. Comparison of American and European practice. First and second terms (3).

34. International Law. The development of international law; its origin and history; economic and political changes determining the development of international relations; the Jus Gentium of the Roman Law and the "Natural Law" jurists. Law of Peace and War: general principles governing the normal relations of states and their relations in time of war.

The Law of Neutrality, with special reference to the contributions of the United States; problems associated with blockade, contraband of war, unneutral service. First and second terms (3).

ECONOMIC GEOGRAPHY

35. Economic Geography of North and South America. Physical features, climate, and resources of the Western Hemisphere; their influence upon the economic, political, and social institutions. The present and prospective commercial relations of the United States with Mexico, Central and South America. First and second terms (3).

36. Economic Geography of the Eastern Hemisphere. Physical features, climate, and resources of the Eastern Hemisphere; their influence upon the economic, political, and social institutions. Study of Great Britain, Germany, Russia, China, Japan, India and the Philippine Islands; the present and prospective commercial relations of these countries with the United States. First and second terms (3).

HISTORY

PROFESSOR STEWART,
ASSISTANT PROFESSORS CURTIS AND BROWN

38. Industrial History. The evolution of modern industrial conditions as found in the growth of the economic powers of Great Britain, Germany and the United States. First and second terms (4).

39. The Political and Constitutional History of the U. S. Prior to 1860. The era of constitution making, state and federal. Rise and growth of party government. The development of nationality and democracy. Political and constitutional questions arising in connection with internal improvements, the tariff, the bank and slavery. First term (3).

40. Political and Constitutional History of the U. S. Since 1860. Continuation of course 39. Second term (3).

41. European History. The formation of the modern European nationalities. The rise of the universities. The revival of learning. The Reformation. The relations of Europe and America. First term (3).

42. European History. The history of modern Europe. The development of Great Britain. The French Revolution and the history of the Nineteenth Century. Second term (3).

43. American Foreign Relations. Studies in the diplomatic relations of the United States with the main countries of Europe, with the Near East and the Far East. First term (3).

44. United States and Latin America. Problems arising out of the relations of South American states to one another and to the United States. Origin, development and application of the Monroe Doctrine. Second term (3).

44a. Thesis. Each candidate for the degree of B.S. in Business Administration is required to present a thesis on some topic related to the work of the College of Business Administration. Second term (3).

LATIN

PROFESSOR WRIGHT

45. Ovid. Selections from the *Metamorphoses*. Vergil. *Bucolics*. Horace. Select *Odes*. Lectures on the history and development of pastoral and lyric poetry. The influence of Latin poetry upon English literature emphasized. Insistence upon tasteful translation. Freshman. First term (3).

46. Horace. *Odes* continued. Catullus. Selections. Constant practice in reading the more important lyric metres. Memorizing of stanzas and passages from Horace. Freshman. Second term (3).

47. Ancient and Mediaeval Civilization. A course aiming to impart a knowledge of ancient and mediaeval life and thought, with special emphasis on literature, art, science and philosophy. Required readings in the best English translations of ancient authors. Assigned topics for investigation and report. Lectures on the art, architecture and daily life of the ancients, illustrated by stereopticon. Freshman. First and second terms (3).

Courses 45 and 46 are required of Freshmen in the B.A. course who enter with four units of Latin; others in that course take 47, except that those who present two or three units in Latin for entrance may, upon the approval of the Professor of Latin, continue Latin instead.

48. Livy. Selections from the books covering the war with Hannibal. Latin prose composition; or: Cicero. *De Senectute. Letters.* Catullus. A study of the literature and social life of republican Rome. Sophomore. First term, elective (3).

49. Plautus and Terence. Careful study of a play of each with rapid reading of as much more as time permits. Private life of the Greeks and Romans. History of the drama at Rome. Sophomore. Second term, elective (3).

50. Satire. Selected satires of Horace and Juvenal. Martial. Selected epigrams. Lectures on the history of Roman Satire and its influence on modern literature. Study of social conditions under the Empire. Junior and Senior. First term, elective (3).

51. Petronius. *Cena Trimalchionis;* or an advanced course in Comedy. Study of the language, syntax, and vocabulary of the *Sermo Plebeius.* Junior and Senior. Second term, elective (3).

52. Vergil. *Aeneid,* Books VII-XII. Lectures on the history of the Epic. Writing of brief dissertations on assigned topics. Juniors and Seniors. First term, elective (3).

53. Lucretius. Careful study of one book entire of the *De Rerum Natura,* with reading of selections from the other books. Consideration of textual questions. Discussion of ancient materialistic theories. Some review of Roman philosophy and ethics. Junior or Senior, elective, second term (3).

54. Courses for prospective teachers of Latin in secondary schools. Largely a review of secondary school Latin, the members of the class conducting the class in turn under the oversight of the Professor of Latin to the end that they may enter upon the teaching of Latin in preparatory or high school with freshened knowledge of the subject, and not without some experience in presenting it. Junior year, first term (2), second term (2). This course ordinarily taken in connection with Education, which see.

54a. Cicero. Orations and Letters. Prose composition and syntax, with special emphasis on clause construction. A course designed for students who enter with two years of high school Latin and who elect to continue their Latin rather than take course 47. First term elective (3).

54b. VERGIL. *Aeneid,* Books I-VI. Prose composition continued. Practice in reading aloud and scansion. Training in sight translation. Some study of the mythology and religion of Greece and Rome. Second term elective (3).

GREEK

PROFESSOR GOODWIN

55. LYSIAS, Selected *Orations;* or XENOPHON, *Memorabilia.* Review of the Grammar. Composition and other exercises. Careful study of Attic prose syntax; special attention given to the formation of correct methods of study and translation, to grammatical analysis, and the reading aloud of Greek. Available time employed in sight-reading. HERODOTUS. One book begun. First term (3).

56. HERODOTUS (continued). Study of the forms and syntax of the Ionic dialect. PLATO. *Euthyphro, Apology,* or other shorter dialogues. Introduction to Greek Philosophy. Grammar and composition as in the first term. Second term (3).

57. THUCYDIDES. One or more books. Practical exercises, including composition. First term (3).

58. TRAGEDY. EURIPIDES. *Medea, Bacchae,* or another play. SOPHOCLES. *Oedipus Tyrannus, Antigone,* or another. Literary study of the drama. Poetical language, style, and conception. Metrical reading. Composition. Second term (3).

59. DRAMATIC POETRY (continued). AESCHYLUS. *Agamemnon,* or *Prometheus Bound.* ARISTOPHANES. *Clouds, Frogs,* or *Birds.* ARISTOTLE. Chapters from the *Poetics.* Aristophanes as humorist and as moralist, with consideration of the tendencies which he satirized. Metres. Elementary text-criticism. First term (3).

60. GREEK ORATORY. Jebb's *Selections from the Attic Orators.* DEMOSTHENES. Selected orations. Rapid reading, the student being supposed to have reasonable facility in understanding the Greek directly without rendering into English. Attention directed largely to those points which illustrate the development of Greek prose style. Second term (3).

61. HOMER. Rapid reading of considerable portions of the *Iliad* or *Odyssey.* Homeric language, syntax, and metre reviewed, with some reference to the needs of intending teachers,

but chiefly as a foundation for the study outlined in course 62. First term (3).

62. Lyric Poetry. Fragments of the Elegiac, Iambic, and Melic Poets. Selections from Pindar or Theocritus. Study of the development of poetry in Greece. Second term (3).

63. Hellenistic Greek. *New Testament.* Selections from Lucian. To be substituted on occasion for 62. Second term (3).

Courses 59 and 61, 60 and 62 (or 63) are offered in alternate years, and are open to both Juniors and Seniors. Candidates for honors in Greek will be assigned special readings on request.

64. Elementary Greek. A course offered (ordinarily only in alternate years) to Freshmen and Sophomores who have entered without Greek, but who desire to take up the study in college. They perform in two years approximately the amount of work required for admission from those who present Greek, and are prepared to proceed in the third year with course 55. The introductory book and a small portion of the *Anabasis* studied in the first two terms. Given in 1922-1923; to be omitted in 1923-1924. First and second terms (3).

65. Elementary Greek, second year. *Anabasis* continued; *Iliad* (if time permits); Grammar and simple Composition. Omitted in the years in which the preceding course is given. First and second terms (3).

GERMAN

PROFESSOR PALMER, ASSISTANT PROFESSOR MORE, MR. ROEST

70. Elementary German. German Grammar and Composition. Easy German texts. First term (3).

71. Elementary German, continued. Composition based on work in the Grammar. Dictation. Reading of short stories by various modern authors. Second term (3).

72. Elementary German. A condensed course for Chemists, Chemical Engineers and Metallurgists who have entered without German. Grammar. Readings in the German of Chemistry. First and second terms (3).

73. German. Rapid reading of selected texts on chemistry. For Sophomores who have passed course 72. First term (2).

75. GERMAN. Thorough review of German Grammar. Prose composition. Modern German Prose; Scientific German. First and second terms (3).

76. GERMAN. The German of Chemistry. Review of German Grammar. Composition. First and second terms (3).

77. GERMAN. German Prose and Poetry. Heine, Keller, C. F. Meyer, Freytag, Storm, Heyse. Composition. First and second terms (3).

78. GERMAN. Modern German Prose. Rapid reading of representative texts. First term (3).

79. GERMAN. Goethe's *Faust*. Study of Part I. Lectures on the origin and development of the Faust story. Second term (3).

80. GERMAN. Nineteenth Century German Drama. Lectures, reading, reports on assigned work. First and second terms (3).

81. GERMAN. Goethe's Dramas: *Goetz, Egmont, Iphigenie, Tasso, Faust*, Part II. First and second terms (3).

82. GERMAN. The German Short Story, its origin and development. Rapid reading of illustrative stories, with particular attention to Gottfried Keller, Theodor Storm, C. F. Meyer, and Paul Heyse. Lectures and reports. First and second terms (3).

83. GERMAN. A course for prospective teachers in advanced German grammar. German composition, methods of teaching and discussion of text-books. First term (2).

ROMANCE LANGUAGES

PROFESSORS FOX, ASSISTANT PROFESSOR TOOHY,
MESSRS. BARZUN, PERKINS, DE MENEZES

FRENCH

90. ELEMENTARY FRENCH. Elementary French Grammar. Easy readings in French prose. Practice in speaking and writing simple French, based upon the texts used. A course intended primarily for Junior students in the College of Arts and Science; introductory to course 97. First and second terms (3).

91. ELEMENTARY FRENCH. An intensive course in Elementary French for Senior Metallurgists. Emphasis upon the develop-

ment of a reading knowledge of French. Grammatical drill limited to the essentials. First term (3).

92. Elementary French. A Sophomore elective for students in the College of Arts and Science who wish three years of French and can therefore give time to a more detailed drill in grammar and composition as well as practice in writing and science; introductory to course 97. First and second terms (3).

93. French. A course for students who wish a greater opportunity to practice in the oral and written use of modern French prose. Especially recommended for those who expect to teach French. First and second terms (2).

94. French. A course for Freshmen who enter on French. Thorough review of the grammar with composition work, both oral and written, based upon the grammar and upon the texts read. Texts selected from writers of modern French prose. First and second terms (3).

96. French. Text and methods. First or second term, or both (1) or (2).

97. French. Rapid reading. Sight translation. Dictation. Oral drill in the use of a practical vocabulary. First and second terms (3).

98. French Prose and Poetry. Balzac, Flaubert, Maupassant, Daudet, Zola. First term (3).

99. French Prose and Poetry. Continuation of course 98. Molière, Corneille, Racine. Society in the seventeenth century. Second term (2).

100. French. French literature in the seventeenth century. First term (3).

101. French. French literature in the eighteenth century. Second term (3).

102. French. Rapid reading of modern French authors, introducing certain of the social and political problems of France and her people today. Reading of texts by such authors as Thiers, Lamartine and Michelet, to furnish the necessary background. First and second terms (3).

103. French. General review of French literature. Reading, lectures and explanation of texts. First and second terms (3).

104. FRENCH. French literature in the nineteenth century. First and second terms (3).

105. FRENCH. French literature in the sixteenth century and earlier. May be substituted in place of 102, 103 or 104. First and second terms (3).

SPANISH

110. SPANISH. Grammar, reading and composition. A course open to all students of the University. First and second terms (3).

111. SPANISH. Reading and discussion in Spanish of texts dealing with the history of Latin American countries. Prose composition. First and second terms (3).

112. A continuation of course 110. First and second terms (3).

113. SPANISH. Reading and discussion in Spanish of texts dealing with the commercial and industrial relations of Latin America. Spanish commercial correspondence. First and second terms (3).

114. (Alternate.) Spanish novels and plays. Short outline of Spanish literature. A second year course, intended more especially for students in the B.A. course; may be substituted by them for course 112. First and second terms (3).

PORTUGUESE

115. PORTUGUESE. Grammar and composition. Rapid reading of modern literature, with particular reference to the history, social and economic conditions of Brazil and Portugal. First and second terms (3).

116. PORTUGUESE. A continuation of course 115. First and second terms (3).

ITALIAN

117. ITALIAN. Grammar and composition. Rapid reading of easy modern prose. First and second terms (3).

118. ITALIAN. Masterpieces of the classic periods; outside reading. First and second terms (3).

ENGLISH

PROFESSORS THAYER AND LUCH,
ASSISTANT PROFESSOR MESCHTER, MESSRS. LAMBERT AND GOFF

120. Rhetoric. A composition course based on Genung's *Working Principles of Rhetoric* and Broughton's *Model Paragraphs*, involving recitations and weekly themes on assigned subjects. First term (2).

121. American Literature. Lectures and recitations on the basis of Pattee's *Century Readings in American Literature* and other text-books, as assigned. Examination based upon the text-book and the student's notes. First term (1).

122. History of the English Language. Lectures and classroom work, with the use of Emerson's *Brief History of the English Language* as a text-book, supplemented by Trench's *The Study of Words* (revised edition). Second term (2).

123. English Literature. An outline course developed by lectures and recitations, with parallel readings assigned annually. Text-book: Cunliffe, Pyre and Young's *Century Readings in English Literature*. First term (2) or (3).

124. Literary Criticism. Subject varying annually between topics taken from Elizabethan literature, lyric or dramatic, and from nineteenth century literature, earlier or later period. In 1923, Shakespeare's historical plays. Second term (2) or (3).

125. Oratory. An introductory course based upon Mosher's *Extempore Speaking*, with recitations, the composition and delivery of orations, and speeches on topics of current interest. Second term (1).

126. Anglo-Saxon. Sweet's *Anglo-Saxon Primer and Reader*, with lectures on early English literature, and readings from Brooke and Earle. First term (3).

127. Technical Writing. A course of practical exercises in writing on scientific subjects. Text-book: Earle's *Technical Writing*. Second term (2), (3) or (4).

128. English Philology. The principles of the philology of the English language as developed in the works of Earle, Trench, Morris and Skeat. By a process of elimination the elements derived from Romance and other sources are excluded,

and the residuum examined, in vocabulary and grammar, as a Teutonic language; with special reference to the intensive development of the tongue before the Age of Chaucer. Preparation required: 126. Second term (3).

129. NINETEENTH CENTURY LITERATURE; later period 1830-1892. A special study of Tennyson, Arnold and Browning and some of the minor poets. Junior elective. First term (3).

130. MIDDLE ENGLISH. A critical study of the English of Chaucer, Langland, Wiclif and Gower; followed by the literary study of selected specimens of their works. Text-books: *The Student's Chaucer*, Skeat's edition of *The Vision of Piers the Plowman*, Wiclif's translation of the *New Testament*, revised by Purvey, and Gower's *Confessio Amantis* assigned. First term (3).

131. POETICS. A course based on Gummere's *Handbook of Poetics*, Alden's *English Verse*, Saintsbury's *Loci Critici*, and the use of Palgrave's *Golden Treasury*, and *The Oxford Book of English Verse*, with practical exercises in verse-composition. Senior elective. Second term (3).

132. DRAMA OF THE PAST. Based on Brander Matthew's *Chief European Dramatists;* with lectures, interpretations and a close study of plots and sources. First term (3).

133. CONTEMPORARY DRAMA. Lectures, criticisms and reading of typical plays. In 1922, American Drama down to date. Second term (3).

134. TWENTIETH CENTURY LITERATURE. The drama, novel, and lyric poetry since 1895. Junior elective. Second term (3).

135. THE DANISH ELEMENTS OF ENGLISH. A philological study based on Sweet's *Icelandic Primer*, Groth's *Danish Grammar* (pp. 1-29, 67-143) and the works of Jespersen and other philologists. Alternative with 130. Preparation required: 126, 128. Second term (3).

136. Optional courses on the Rise and Development of the English Novel and on the Arthurian Cycle offered in alternate years. Lecture courses, with private reading assigned; if supplemented by a rigid examination, taken as equivalent to one term's work in any class above the grade of Freshman.

137. ENGLISH CONFERENCES. First or second term (1), (2) or (3).

MATHEMATICS AND ASTRONOMY

PROFESSORS THORNBURG, LAMBERT AND OGBURN
ASSOCIATE PROFESSORS STOCKER AND REYNOLDS,
ASSISTANT PROFESSOR KNEBELMAN, MESSRS. LEYZERAH, SOLT, LYLE

140. Solid Geometry, beginning with Book VI and completing the subject. Second term (3).

141. Trigonometry. Plane Trigonometry, including the theory and use of logarithms. First term (3).

142. Trigonometry. Spherical Trigonometry, including the use of logarithmic tables. Second term (1).

143. Anvanced Algebra, beginning with the Theory of Quadratic Equations. Review of Plane Trigonometry and Elementary Algebra. First term (4).

144. Higher Algebra. Theory of Equations and other topics. First term (1).

145. Plane Analytic Geometry. Graphic representation of loci on cross-section paper, plane analytic geometry. Second term (3).

146. Differenial Calculus and Solid Analytic Geometry. Embracing applications to analytic geometry and practical problems. Preparation required: 145. First term (4).

147. Integral Calculus. General integration methods with applications to theory of center of gravity, moment of inertia, together with a short chapter on elementary ordinary differential equations. Preparation required: 146. Second term (4).

148. Differential Equations. Preparation required: 147. First term (1).

149. Analytic Mechanics. Differential equations of motion, treatment of forces in space, free and constrained motion of a particle and of masses, with applications to practical problems. Preparation required: 147. First term (2).

150. Descriptive Astronomy. A study of the fundamental facts and principles of the subject with solution of problems; observatory visits. First or second term (3).

151. Practical Astronomy. Study of instruments used, methods of taking and reducing observations to determine time, latitude, longitude and azimuth; observatory work in

which each student makes his own observations and computations in illustration of the problems studied. As this study is primarily for civil engineers, the sextant and engineer's transit are the chief instruments employed in the observational work. Preparation required: 141, 142, 147, 150. First term (3).

152. Analytic Mechanics. Preparation required: 147, 148, 149. Second term (3).

153. Navigation. Study of principles and instruments used in navigation, with practical navigation problems by modern methods. Second term (2).

CIVIL ENGINEERING

PROFESSORS FOGG AND WILSON,
ASSOCIATE PROFESSORS BECKER AND FULLER,
ASSISTANT PROFESSORS PAYROW, LEWIS AND UHLER, MR. CLARK

160. Engineering Drawing. The use of drawing instruments. Lettering and tracing. Mechanical drawing of objects. Simple projections. Isometric drawing. First term (3).

161. Engineering Drawing. The descriptive geometry of projections, intersections, and developments. Plans, elevations and sections of simple structural details. Preparation required: 160. Second term (2).

162. Engineering Drawing. The use of drawing instruments, lettering and simple projections. Second term (1).

163. Engineering Drawing. The descriptive geometry of projections, intersections and developments. Isometric drawings, plans, elevations and sections of simple structural details. Preparation required: 162. First term (3).

164. Engineering and Topographic Drawing. Problems in stone cutting, including plans for pipes, culverts and arches. Isometric drawings and linear perspective. Topographic maps. Preparation required: 163. Second term (2).

165. Land and Topographic Surveying. The theory and practice of land surveying, including computation of areas, dividing land, determining heights and distances. Map drawing and topographic signs. Field work with level and transit. Map drawing from students' field notes. Theory and use of stadia. Detailed field work in rough country; pen topography and contour maps. Preparation required: plane trigonometry and

engineering drawing. Summer term: a recitation and seven hours of field work each week-day for three weeks, beginning June 13, 1923.

166. Railroad Surveying. Reconnaissance, preliminary and location methods, with the theory of curves. Preparation required: 165. Summer term: a recitation and seven hours of field work each week-day for two weeks, immediately following course 165.

167. Strength of Materials. The elasticity and strength of timber, brick, stone, and metals. Theory of beams, columns, and shafts, with the solution of many practical problems. Preparation required: 320, 321, 323, 147. First term (4).

167a. Strength of Materials. An abridgment of course 167. Preparation required: 320, 321, 323, 147. First term (3).

168. Strength of Materials Laboratory. Fourteen experiments made by each student on wood, iron and steel to determine the action of materials under stress and to study the physical properties of materials of construction. The Fritz Engineering Laboratory, where this work is done, is equipped with 20,000, 50,000, 100,000, 300,000 and 800,000-pound machines for tension, compression and flexure, a 50,000-inch-pound machine for torsion and other apparatus for special work, In conjunction with 167 or 167a. Fee, $5. First term (1).

169. Railroads. Theory of curves and turnouts. Preparation of profiles and maps. The computation of earth work and estimates of cost. The construction of road-bed, including ballast, cross ties, rails, switches, culverts and other details. Preparation required: 166. First term (4).

170. Hydraulics. Hydrostatics and theoretical hydraulics. The flow of water through orifices, weirs, tubes, pipes, and channels. Naval hydromechanics. Hydraulic motors. The solution of many practical problems. Preparation required: 320, 321, 323, 147. Second term (3).

170a. Hydraulics. An abridgment of course 170. Preparation required: 320, 321, 323, 147. Second term (2).

171. Hydraulic Laboratory. Fourteen experiments made by each student in the hydraulic section of the Fritz Engineering Laboratory, which is equipped with pumps, weirs, turbines,

water-wheels, meters and other apparatus for special work. In conjunction with 170 or 170a. Fee, $5. Second term (1).

172. Roofs and Bridges. Analytical and graphical determination of stresses in roof and bridge trusses under dead, live and wind loads. Locomotive wheel loads on plate girders and bridge trusses. Preparation required: 167. Second term (4).

173. Highway Engineering. The location, construction and maintenance of roads and pavements. Highway design. Preparation required: 165, 166. Second term (3).

174. Graphic Statics and Surveying. A special course given to Junior Mechanical Engineering students. The first part of the term devoted to the graphical determination of stresses in roof trusses by the force polygon. The last part of the term devoted to elements of plane surveying, including field work. Second term (3).

175. Structural Steel Design. Lectures and recitations. Theory of structural steel design and complete calculations for a through plate girder railroad bridge and for a highway truss bridge. Design of mill buildings and miscellaneous structures. Preparation required: 172. First term (3).

176. Structural Steel Design. A special course arranged for Seniors in Ship Construction and Marine Transportation. A study of the stresses acting on steel structures, with special attention to the local stresses in a ship's structure; the design of cranes, warehouses and other steel structures; solution of problems by graphical methods. Preparation required: 167. First term (4).

177. Bridge Design Drawing. Complete shop drawing for a single track through railroad bridge and a design drawing of a highway truss bridge for which calculations are made in course 175. Preparation required: 172. First term (3).

178. Graphic Statics. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to the discussion of beams and girders. First term (2).

179. Hydraulic and Water Power Engineering. Three recitations and one drawing-room exercise a week devoted to systems of water supply, including purification systems, reservoirs, pipe lines, pumping plants. The design of a water supply

distribution system. The measurement of flow in open channels by means of tubes and meters. Water power. Irrigation. Preparation required: 170. First term (4).

180. Geodesy. Recitations, calculations, field work. Precise leveling. Adjustment of instruments with investigation of their systematic errors. Elements of least squares and their application to the adjustment of triangulations. Field work in triangulation, in determination of azimuth, and with the plane table. Preparation required: 165, 166. First term (3).

181. Railroads and Terminals. Maintenance of way, and the elements of railroad operation. Lectures on the economics of railroad location; the arrangement of yards, stations and terminals, train resistance, the application of electricity to the operation of railroads. Preparation required: 169. First term (3).

182. Higher Structures. Theory of continuous, draw, cantilever and suspension bridges, also metallic arches. The theory and design of masonry walls, dams, and arches. Theory of deflections and applications to statically indeterminate structures. Preparation required: 175. Second term (3).

183. Reinforced Concrete Design and Foundation. Theory of reinforced concrete; design of reinforced concrete buildings, arches and miscellaneous structures. Foundations. Preparation required: 175. Second term (3).

184. Cement and Concrete Laboratory. The manufacture, properties and testing of cement, mortar and concrete. All the standard tests made by each student on cement and on reinforced concrete beams and columns in the Fritz Engineering Laboratory. Preparation required: 183. Fee, $3. Second term (1).

185. Contracts and Specifications. Lectures on the essentials of contracts and specifications for engineering structures. Second term (2).

186. Sanitary Engineering. Systems of sewerage and methods of sewage treatment and disposal. The design of a sewerage system. House drainage. Preparation required: 179. Second term (3).

SUMMER SCHOOL IN CIVIL ENGINEERING

165. Land and Topographic Surveying. Exercises in land and topographic surveying, designed primarily for students of the University, but open to all persons prepared to take them, are given in the summer vacation. In 1923, this work begins at 8 a.m., on June 13, and runs for three full weeks. Students in Civil Engineering, in Mining Engineering and in Ship Construction and Marine Transportation are required to take this work. The fee for other persons is $30.

166. Railroad Surveying. Exercises in railroad surveying, beginning immediately after the close of course 165 and running for two full weeks.

187. Summer Work in Civil Engineering. During the summer following the Junior year, students are required to spend at least eight weeks on shop work or on engineering construction.

MECHANICAL ENGINEERING

PROFESSORS LARKIN, KLEIN AND BUTTERFIELD,
ASSOCIATE PROFESSOR MEASE,
ASSISTANT PROFESSORS QUAST AND NORDENHOLT,
MESSRS. LEACH, KOLB AND KISTLER

200. Drawing and Elements of Machine Design. Orthographic, isometric and oblique projections, intersections and developments. Sketches and working drawings of machine pieces, tracings, details of screw-fastenings, keys and other fastenings. French's *Engineering Drawing*. First term (3).

201. Heat Engines. Classification and types of engines, governors, valve gears, valve diagrams, indicator diagrams, efficiency. Fuels, combustion, boilers, superheaters, feed water heaters, condensers. Hirshfeld and Barnard's *Elements of Heat Power Engineering*. First term (3).

202. Mechanism. A study of the mechanics of machine parts. Development of links, cams, gears, transmission machinery and the determination of dimensions from a standpoint of strength and durability taken up in detail in the class room. Practical problems developed in the drawing room. Keown's *Mechanism*. First term (3).

203. Elements of Machine Design. Calculations of the d mensions of elementary machine parts such as spur-, beve and worm-gears, pulleys, shafting, couplings, bearings, cor necting rods, etc., from the forces acting upon or transmitte by such machine parts. Working drawings of these piece Mease and Nordenholt's *Elements of Machine Design*. Prepara tion required: 200. Second term (3).

204. Heat Engines. Continuation of 201. Hirshfeld an Barnard's *Elements of Heat Power Engineering*. Secon term (3).

205. Mechanism. Continuation of 202. Keown's *Mechanism* Second term (3).

206. Graphic Statics of Mechanisms. Graphical determina tion of the forces acting on all the various pieces constitutin a machine, covering a great variety of machines; drawings c these machines given to the students. Consideration of fri tional and inertia resistances and determination of the e ficiencies of mechanisms. Text: Department Notes and Plate Preparation: 203, 205. Fee, $2.50. First and second terms (2

207. Heat Engines. Theory of Steam Turbines, Interna Combustion Engines, Gas Producers and Refrigeration. Clas and drawing room work. Preparation required: 204. Hirsh feld and Barnard's *Elements of Heat Power Engineering* First term (4).

208. Engineering Laboratory. Use and calibration of a paratus for measuring weight, volume, pressure, temperatur speed, etc., for engineering purposes. Carpenter & Diederich *Experimental Engineering*. Fee, $3.50. First term (1).

209. Heat Engines. Theory of Steam Turbines, Interna Combustion Engines, Gas Producers and Refrigeration. Co tinuation of 207. Hirshfeld and Barnard's *Elements of Hea Power Engineering*. Second term (4).

210. Engineering Laboratory. Work of 208 continued. I dicator practice on engines in the laboratory and in factori and power plants in the neighborhood; complete working u of indicator diagrams from simple and compound engines, a compressors, etc. Carpenter & Diederich's *Experimental Engi neering*. Fee, $3.50. Second term (1).

211. Advanced Machine Design. The design of machines in general, with special attention to the calculation and designing of the various parts for strength, stiffness and other requirements. Problems covering such machinery as cranes, hoists, pumps, machine tools, hydraulic machinery, etc. Kimball and Barr's *Machine Design*. First term (4).

212. Mechanical Engineering. Advanced work in Thermodynamics, Internal Combustion Engines and Steam Turbines with typical problems. Emsweiler's *Thermodynamics*, Streeter's *Gas Engines*, and Moyer's *Steam Turbines*. First term (4).

213. Engineering Laboratory. Work of 208 and 210 continued. Test of boilers, of power plants and pumping stations in the neighborhood. Carpenter and Diederich's *Experimental Engineering*. Fee, $3.50. First term (1).

214. Thesis. Each candidate for the degree of Mechanical Engineer is required to present a satisfactory thesis on some topic, showing a grasp of the underlying principles of the subject investigated. Second term (3).

215. Advanced Machine Design. Continuation of 211, being more specialized. Kimball and Barr's *Elements of Machine Design*. Second term (4).

216. Mechanical Engineering. Continuation of 212. Advanced work in Pumping Machinery, Air Machinery, and Refrigeration, with typical problems. Greene's *Pumping Machinery*, Peele's *Compressed Air*, and Greene's *Elements of Refrigeration*. Second term (4).

217. Engineering Laboratory. Work of 213 carried forward, along same lines. Analysis of flue gases; complete tests of power plants of the vicinity. Carpenter and Diederich's *Experimental Engineering*. Fee, $3.50. Second term (1).

218. Heat Engineering. The laws of gases and the gas cycles; the properties of steam and other vapors, the vapor cycles, entropy and the temperature-entropy diagram; a study of the theory of prime movers and the action of steam in engines and turbines; the use of the steam tables, the Mollier and temperature entropy diagrams. For students in the Course of Ship Construction and Marine Transportation. Hirshfeld and Barnard's *Elements of Heat Power Engineering*. First term (3).

219. Marine Engines and Turbines. A detailed study of the multiple expansion reciprocating engine, the steam turbine and the Diesel engine. A study of the theory, economy and design of these three prime movers in the class room, supplemented by work in the laboratory. For students in the Course in Ship Construction and Marine Transportation. Hirshfeld and Barnard's *Elements of Heat Power Engineering*, Stirling's *Handbook*, Chapman's *Marine Power Plants*, Supino's *Land and Marine Diesel Engines*. First term (3).

220. Engineering Laboratory. A shorter course, selected and condensed from 208, 210, 213 and 217, especially in steam engineering, for students in courses other than Mechanical Engineering. Carpenter and Diederich's *Experimental Engineering*. Fee, $3.50. First term (1).

221. Heat Engines. Short course for students in courses other than Mechanical Engineering, covering Steam Engines, Steam Turbines, Internal Combustion Engines and Boiler Plants. Hirshfeld and Barnard's *Elements of Heat Power Engineering*. First term (3).

222. Heat Engines. Work of 221 completed. Hirshfeld and Barnard's *Elements of Heat Power Engineering*. Second term (3).

223. Heat Engines. Classification and types of engines and power plant auxiliaries and apparatus, fuels, combustion, steam turbines, internal combustion engines; a composite course for students in the course in Chemical Engineering. Hirshfeld and Barnard's *Elements of Heat Power Engineering*. First term (3).

224. Heat Engines. Continuation of 223. Hirshfeld and Barnard's *Elements of Heat Power Engineering*. Second term (3).

225. Engineering Laboratory. A summer course of four weeks for students in Chemical Engineering, comprising a series of experiments and tests of heat transfer, apparatus, calorimetry, heat engines and auxiliaries. Preparation required: 223, 224. Carpenter and Diederich's *Experimental Engineering*. Fee, $3.50. Summer term (3).

226. Engineering Laboratory. Work of 220 completed, along same lines. Carpenter and Diederich's *Experimental Engineering*. Fee, $3.50. Second term (1).

227. Work in Industrial Plant. Following the Sophomore year students are required to spend a minimum of eight weeks in industrial plants of approved character. A report is required. (3)

228. Student Apprenticeship, or Engineering Construction or Shop Work. Following the Junior year students are required to do a minimum of eight weeks of practical work, preferably as student apprentices, in the work they plan to follow after graduation. A report is required. (3)

METALLURGY

ASSOCIATE PROFESSOR ROUSH,
ASSISTANT PROFESSORS BUTTS AND PULSIFER

241. History of the Metals. A course of lectures designed to familiarize the beginning student with the historical phases of metallurgy and the importance of metals in the development of civilization. Preparation required: 390. Second term (1).

242. Introductory Metallurgy. A course of lectures on the properties and uses of the various metals, the geographical distribution of their ores and the condition of their production; their present economic and mechanical importance. Preparation required: 241. First and second terms (1).

243. General Metallurgy. A course of lectures discussing the general principles of Metallurgy as applied to the metallurgy of the various metals. Ores, fuels, combustion, pyrometry, refractories, furnaces, metallurgical processes and products, metals and alloys, slags and fluxes, blast and gases, smoke and fume. Hofman's *General Metallurgy;* Fulton's *Principles of Metallurgy.* Preparation required: 242, 398, 399. First term (2).

244. Metallurgical Problems. A course of problems embodying the use of the physical, chemical and mechanical principles as the basis of practical metallurgy. Data taken from actual practice, so that the results have an important bearing in the understanding of metallurgical processes. Reference: Richards' *Metallurgical Calculations, Part I.* Preparation required: 242, 397. Must accompany course 243. First term (1).

245. METALLURGY OF IRON AND STEEL. Chemical and physical properties of iron. Iron ores. Preparation of ores. The blast furnace. The mixer. Remelting. Refining. Puddling. The Bessemer process. The open-hearth process. Duplex process. Cementation. Manufacture of crucible steel. Electric steel. Alloy steels. Direct processes. Casting, forging and heat treatment. Reference books: Stoughton's *Metallurgy of Iron and Steel;* Austin's *Metallurgy of the Common Metals.* Preparation required: 243. Second term (2).

246. METALLURGICAL PROBLEMS. A course of problems involving the fundamental principles of the various processes in the metallurgy of iron and steel, to give the student an understanding of the quantitative relationships in the processes. Richards' *Metallurgical Calculations, Part II.* Preparation required: 243, 244, must accompany course 245. Second term (1).

247. METALLURGY. Short course. An abridgment of courses 243, 244, 245, and 246 for students in Civil, Mechanical, Electrical and Mining Engineering, Ship Construction and Marine Transportation. Reference books: Hofman's *General Metallurgy,* Stoughton's *Metallurgy of Iron and Steel,* Austin's *Metallurgy of the Common Metals,* Richards' *Metallurgical Calculations, Parts I and II.* Preparation required: 390, 397, 321. Must accompany or be preceded by 324. First or second term (3).

248. METALLURGY OF COPPER, LEAD, SILVER, GOLD. COPPER: Chemical and physical properties. Ores. Smelting sulphide ores. The Bessemer process. Treatment of oxide ores. Wet process. Electrolytic processes. LEAD: Chemical and physical properties. Ores. Smelting processes. Condensation of lead fume. Refining and desilverization of base bullion. SILVER: Chemical and physical properties. Ores. Smelting with lead. Amalgamation. Leaching processes. GOLD: Chemical and physical properties. Ores. Gold washing. Gold milling. Chlorination. The cyanide process. Parting gold and silver. Reference books: Schnabel's *Handbook of Metallurgy,* Gowland's *Metallurgy of the Non-Ferrous Metals,* Austin's *Metallurgy of the Common Metals,* Hofman's *Metallurgy of Copper,* Hofman's *Lead,* Collins' *Silver,* Rose's Gold. Preparation required: 234; for Mining Engineers, course 247. First term (2).

249. METALLURGICAL PROBLEMS. A course of problems concerned with the principles utilized in the metallurgy of copper, lead, silver and gold. Reference: Richards' *Metallurgical Calculations, Part III.* Preparation required: 244. Must accompany course 248. First term (1).

250. METALLURGY OF ZINC, MERCURY, TIN, ALUMINIUM, NICKEL, ETC. ZINC: Chemical and physical properties. Ores. Reduction by furnace and electrolytic processes, electrothermic processes. Manufacture of zinc oxide. MERCURY: Chemical and physical properties. Ores. Processes of extraction. ALUMINIUM: Chemical and physical properties. Ores Extraction by electrolysis. TIN, NICKEL, PLATINUM, ANTIMONY, etc.: Chemical and physical properties. Ores. Processes of extraction. Reference books: Schnabel's *Handbook of Metallurgy*, Gowland's *Metallurgy of Non-Ferrous Metals*, Austin's *Metallurgy of the Common Metals*, Ingall's *Zinc*, Richards' *Aluminium*, Louis' *Metallurgy of Tin*, Wang's *Antimony*. Preparation required: 243. Second term (2).

251. METALLURGICAL PROBLEMS. A course of problems concerned with the principles utilized in the metallurgy of zinc, mercury, aluminium, etc. Reference: Richards' *Metallurgical Calculations, Part III.* Preparation required: 244. Must accompany course 250. Second term (1).

252. ELECTROCHEMISTRY. Lectures discussing the historical development of the subject, particularly the phenomena of electrolysis and the various theories proposed to account for them. Current phenomena. Voltage phenomena. Energy relations. Electrode reactions. The electrolytic cell. Electrothermics. Reference books: Le Blanc's *Text-book of Electrochemistry*. Allmand's *Applied Electrochemistry*. Preparation required: 398, 399, 419, 421. First term (1).

253. ELECTROMETALLURGY. Lectures discussing the practical application of electricity to metallurgical processes. Electrolytic and electric furnace plants and practice. Reference books: Borcher's *Electric Smelting and Refining*. Allmand's *Applied Electrochemistry*. Preparation required: 243, 252. Second term (1).

254. ELECTROCHEMISTRY AND ELECTROMETALLURGY. A combination of courses 252 and 253, for students in Electrical and

Mining Engineering. Preparation required: 247. First term (2).

255. Electrochemical Laboratory. Quantitative relations in the deposition of metals by electrolysis. Experimental study of the conditions controlling the nature of electrolytic deposits. Electrolysis of fused salts. Cathodic and anodic reactions. Fee, $5. Must accompany course 252. First term (1).

256. Metallurgical Laboratory. Calibration and use of instruments employed in metallurgical investigations, pyrometers, calorimeters, etc. Determination of specific heats, latent heats of fusion and vaporization, vapor tensions, heats of combustion, heats of chemical combination and reaction. Heat conduction and radiation. Determination of efficiencies of furnaces. Experiments with electrochemical processes, electric furnaces, etc. Preparation required: 243, 245. Fee, $10. Second term (2).

257. Metallography. The study of metals and alloys: their physical, chemical and microscopic properties together with deductions drawn therefrom. The influence of thermal and mechanical treatment on physical properties and structure. Lectures and laboratory work. Reference books: Gulliver's *Metallic Alloys*, Sauveur's *Metallography and Heat Treatment of Iron and Steel.* Preparation required: 243, 245, 167, 168. Fee, $10. First term (3).

258. Seminary. A conference hour of the staff of the Department with students, to discuss current metallurgical processes and problems, and thesis work, involving some reading of current literature and other preparation on the part of the students. First term (3). Second term (2).

259. Thesis for Degree. Presentation by every student in Metallurgy of a thesis on some topic which requires original literary and other work, such as observations, calculations, or experimental tests when practicable. Second term (3).

GEOLOGY

PROFESSOR MILLER, ASSISTANT PROFESSORS TURNER AND FRETZ, MR. BEHRE

266. Mineralogy. The principles of crystallography with practice in the determination of forms of models and crystals. The physical properties, origin, occurrence, association and

alteration of minerals. A study of about two hundred of the common mineral species and varieties, particularly the rock-forming minerals, with practice in identification based on association and physical properties. Deposit, $5. First term (4).

267. Blowpipe Analysis. A course in qualitative blowpipe analysis and special chemical tests in which the chemical and physical behavior of all the common chemical elements and their compounds under various conditions is noted. Methods of rapid qualitative tests as a means of identifying minerals and chemical compounds with the aid of the blowpipe. Fee, $4. First and second terms (1).

268. General Geology. A course in dynamic, structural, and historical geology. Text-book, supplemented by illustrated lectures in which the relation of geology to engineering problems is discussed. The different geologic periods and their characteristic types of life. The principles of organic evolution as shown in the development of new forms in the successive periods are treated; also a brief review of the geology of the North American continent and the physical changes which it has undergone during its development. Second term (2).

269. Geological Laboratory and Field Trips. A study, during the winter months, of the various types of rocks, to enable students to determine and classify them without a microscope. Principles of rock classification presented in a series of lectures, supplemented by laboratory practice with a petrologic collection comprising rocks from all parts of the country. Attention given to the examination of the varieties of rocks used for constructional purposes with discussions of the factors which render them desirable. A series of lectures on primary and secondary rock structures, supplemented by laboratory work on the interpretation and construction of topographic and geologic maps and sections. Field trips weekly, during the spring months, to nearby localities to study rock structures and deposits of economic importance.

The region furnishes excellent examples of varied structures and contains numerous quarries where slate, cement rock, limestone, sandstone, gneiss and serpentine are obtained, all of which are visited by the classes. On such field trips, special

attention is given to the methods of geologic mapping. Fee, $1. Second term (2) or (1).

270. Economic Geology. A study of the origin, modes of occurrence, properties, sources, production, and uses of the nonmetallic mineral products. Preparation required: 266, 268, 269. First term (2).

271. Economic Geology. A study of the metallic mineral products. Causes of the formation of cavities in rocks, their relation to metalliferous deposits; discussion of the theories of ore-deposition; the structure, geologic horizon, and geographic distribution of the principal metallic economic deposits of the United States. Recitations, illustrated lectures, field trips, and laboratory work. Visits, for the purpose of studying ore occurrence, to the zinc mines of Franklin Furnace, N. J., and Friedensville, Pa., the magnetite mines of Dover, N. J., and Cornwall, Pa., and the anthracite coal regions. Preparation by each student of a series of maps illustrating the location, production, and geology of the economic products of the United States. Preparation required: 266, 268, 269. Second term (4).

272. Paleontology. An elementary course in paleontology in which the animal life of the past is considered from both the biological and geological viewpoints. Theories of origin and evolution of life; principles of stratigraphy and paleontology. Study in the laboratory of index fossils of the successive geologic periods. Preparation required: 268, 269. Second term (3).

273. Geology of North America. The geological age and geographical distribution of the rocks of which North America is composed; the structure and history of its mountain ranges; the history of its geological development and origin; reviews of the great surveys that have been made. Lectures and laboratory work. Preparation required: 268, 269. Second term (3).

274. Physiography. The cosmic relations of the earth; the classification of land forms; the study of their origin, growth, and decay and the factors governing their development. Study of topographic and geologic maps. The relation of topography to geologic structure. The response of man and other organic life to an inorganic environment with special reference to the influence of physiography upon the economic development of

countries. Brief study of weather and climate. Second term (2).

275. Field Geology. Geological maps—their use and the methods by which they are constructed. Practice in the actual working out of surface geology. Problems in plotting geology on topographic maps, each student being assigned a definite area and required to make a geological map of it with structure sections. Collection by each student of a full set of specimens to illustrate the geology. The first part of the course is devoted exclusively to field work and the notes and specimens are studied in the laboratory when the weather prevents further out-door work. Preparation required: 268, 269. Fee, $1. First term (3).

276. Petrography. The optical properties of minerals and their study with the petrographic microscope. Petrography of the most important igneous rocks. Lectures, recitations and laboratory work. Preparation required: 266, 325. Fee, $3. First term (2).

277. Physiography. A study of topographic forms and the processes that have produced them; the weather and climate; and the influence of physical conditions upon the development of countries. First term (2).

278. Physiography. A continuation of course 277. Recitations, lectures and laboratory work. Physiographic regions of North America and Europe. Topographic maps and the preparation of weather and climate charts. Emphasis on the effect that physiographic conditions have in determining the commercial and industrial importance of nations. Second term (2).

279. Mining and Geologic Law. A study of the legal matters that confront a mining geologist. The law in regard to underground waters and mineral products. Preparation of abstracts of important cases, accompanied by drawings showing the geologic conditions upon which the decisions were made. First term (1).

280. Structural Geology. The study of special features of structural geology in the field and laboratory. First term (1).

281. Geologic Methods. The study of methods employed by the geologist in the various lines of geologic investigation.

Methods used by the United States Geological Survey and by the mining companies that employ geologists. Special attention to the problems that confront an economic geologist in the investigation of coal lands, oil properties, metal mines, etc. Second term (3).

BIOLOGY

PROFESSOR HALL, MR. KREIDLER

290. Botany. An elementary course treating of the structure and classification of plants. Preparation advantageous: 292. Second term (3).

291. Forestry. Lectures, recitations and laboratory work. A brief introduction to botany, followed by lectures on dendrology and text-book work on forestry. Laboratory work devoted mainly to dendrology and the characteristics of the wood of important timber species. Field trips during the autumn to enable the student to become familiar with the trees of the region. First term (2).

Careful consideration has been given by friends of the University and by the Board of Trustees to the matter of forestry in connection with the conservation of our natural resources. It does not appear to the Trustees that the present demand for professional foresters is such as to justify the establishment of a school of forestry at the University. It does appear that the question is of such great and growing importance that the University should do its part toward calling the attention not only of its students but of the section of country reached by the influence of the University to the need of a better knowledge of the principles involved. To this end courses of lectures have been instituted to which the public is invited and special instruction is given in forestry in certain of the courses.

In furtherance and support of the cause of Forestry the University has offered free tuition scholarships to graduates of the Pennsylvania State School of Forestry at Mont Alto, to pursue, as special students at this University, courses supplementary and cognate to their studies at Mont Alto.

292. Biology. Recitations from a text-book, laboratory work and lectures on the following topics: (*a*) fundamental concep-

tions; life, protoplasm, the cell, etc.; (*b*) the more important biological theories; variation, heredity, evolution, etc. In the laboratory, types of the various phyla are dissected and drawings made. Fee, $3. First term (3) or (5).

293. Comparative Anatomy of Vertebrates. Text-book work and recitations on the comparative anatomy of vertebrates, with a more extended discussion of biological theories. Laboratory work consisting of the dissection of types of the several vertebrate classes. Preparation required: 292. Second term (3).

294. Vertebrate Embryology. Lectures, text-book and laboratory work. Study of living, preserved, and sectioned material demonstrating the successive stages of cleavage, gastrulation, and the formation of organs. Preparation required: 293. First term (3).

295. Sanitary Biology. Lectures, recitations, assigned reading and laboratory work. Study of bacteria; microscopical appearance, methods of staining, plate and tube culture, etc. The quantitative and qualitative bacteriological and microscopical examination of water. Fee, $3. Second term (2).

296. Bacteriology. Recitations and laboratory work. General study of bacteria. Special attention to those forms which are economically important, such as those of water, foods, dairy products, soils, etc.; the action of preservatives. Preparation advantageous: 290 or 292. Fee, $3. First term (2).

297. Advanced Bacteriology. Lectures and recitations on the study of disease, immunity and sanitation. Laboratory work on the determination of species, with a special study of the pathogenic bacteria. Opportunity is given for the independent study of special problems in practical hygiene. Preparation required: 295 or 296. Fee, $3. Second term (2).

298. Physiology. A course in normal physiology, hygiene and sanitation aiming to give that knowledge of the body and its functions which all should have. Emphasis on the application of such knowledge to personal hygiene and public sanitation. Second term (2).

HYGIENE

DR. ESTES

299. Hygiene. Lectures on methods of personal hygiene and sanitary laws. For the benefit of engineering students who

may later, as engineers and explorers, be charged with the health oversight of men, suggestions are given in this course regarding the physical care and sanitary comfort of working groups.

MINING ENGINEERING

PROFESSOR ECKFELDT, ASSOCIATE PROFESSOR BARTLETT

300. MECHANICAL DRAWING. The use of instruments. Lettering and tracing. Isometric drawing. Sketches and working drawings of simple machine parts. Blue printing. DESCRIPTIVE GEOMETRY. Projections, intersections, and developments of cylinders, prisms, cones, etc. Application to graphical solution of mining problems. Second term (2). First term (1) or (2).

301. MINING ENGINEERING, PROSPECTING. Modes of occurrence of minerals. Uses of geology. Prospecting for placers, veins and beds. Magnetic prospecting. Drilling, sampling. Valuation of property. Location of claims. Patenting mining ground. BORING. Use of bore-holes. Methods: by percussion and rotation. Special methods. Shaft sinking by boring. Survey of bore-holes. EXPLOITATION. Location of plant. Rock drilling; tools and machines. Explosives; blasting; safety regulations. Shaft and slope sinking; tunneling. Supporting excavations by timber, metal, masonry, or concrete. Systems of mining underground and at the surface. HAULAGE. Surface and underground methods. Motors and cars, wire rope, aerial tramways. Loading and unloading, storage of minerals. Transportation of workmen. Signaling. First term (4).

302. ORE DRESSING. General principles and physical properties upon which the recovery of minerals or metals from ores are based, followed by detailed study of machines and apparatus used in modern practice for coarse and fine crushing; classifying and preparation for concentration; various methods of concentration, including gravity and magnetic methods, oil flotation, etc. Application of above methods to various ores; mill schemes or flowsheets. Study of procedure followed for treatment of ores and coal in typical modern concentrating plants. Mill location, construction, arrangement of machinery, operation and costs. Visits to mills and anthracite breakers.

ORE DRESSING LABORATORY. Experimental work and tests on ores, giving practical application of principles and processes covered. A well equipped modern laboratory gives opportunity for individual as well as class operation of the most approved machinery for the preparation of ores. Fee, $5. First term (3).

303. MINING ENGINEERING. HOISTING. Motors, ropes, attachments, receptacles. Safety appliances. Systems of hoisting. DRAINAGE. Surface water; prevention of access. Mine dams. Tunnel drainage. Mechanical drainage; water hoisting; pumping. Classes of pumps. VENTILATION. Atmosphere of mines. Pollution of air. Natural and mechanical methods of ventilation; systems. Types and efficiencies of ventilating machines. Instruments for testing air. Ventilating laws. LIGHTING. Methods employed. Safety lamps; electric lighting. Safety regulations. FIRST AID. Accidents; classes, causes. Means of prevention. Rescue work. Hygiene of mines; rules and laws. First Aid to injured. RAILROAD CONSTRUCTION. Earthwork, trackwork, trestles, bridges, railroad structures, water tanks, yards. Second term (4).

304. MINE SURVEYING. Instruments. Forms of notes. Outside work. Determination of meridian. Inside work. Connecting outside and inside work through shafts, slopes, or tunnels. Calculation of notes; mapping. RAILROAD SURVEYING. Preliminary and location methods; theory of curves, turnouts, etc. Care of maps. Detection of errors. Special problems. Fee, $1. Summer term at the end of Junior year, three weeks, beginning July 5, 1923.

305. MINING ENGINEERING. CONSTRUCTION MATERIALS. The use of stone, brick, concrete, metal and wood for foundations, piling, dams, reservoirs, retaining walls, mine buildings, railroads, trestles, tipples, ore bins and docks. MINE ADMINISTRATION. Organization, employment of labor, management, mine accounts, principles of mining. First term (3). Second term (1).

306. OIL AND GAS TECHNOLOGY. Origin and distribution of petroleum and natural gas. General survey of the geological conditions surrounding their accumulation. Oil shales. Prospecting and mapping. Location of wells. Drilling; pumping.

Special methods. Storage. Pipe lines. Tank cars. Second term (2).

307. Mining Design. The design of parts of mining plant to meet given conditions, with detailed working drawings, accompanied by estimates of material and costs. Second term (3).

308. Prospecting. Surface indications of minerals, including oil, gas and water. Geological interpretation of strata and out-crops. Prospecting on surface and underground. Boring; magnetic prospecting. Mapping. Sampling and valuation of prospects. Locating and patenting claims. This course is offered as an elective for B.A. students. First term (2).

PHYSICS

PROFESSOR MAC NUTT, ASSOCIATE PROFESSOR FRY, ASSISTANT PROFESSORS FRAIM, MARTIN AND KLEIN, MESSRS. CONCILIO, GLENTZER, CARLTON, ZINSZER

320. Elementary Mechanics. Statics. Lecture demonstrations and recitations. First term (3).

321. Elementary Mechanics. Dynamics. Heat. Lecture demonstrations and recitations. Second term (3).

322. Physical Measurements. Laboratory and lectures. Fee, $6. Second term (1).

323. Elementary Physics. Electricity and magnetism. Lecture demonstrations and recitations. First term (3).

324. Physical Laboratory. Mechanics, heat and electricity. Preparation required: 322. Fee, $6. First term (1).

325. Elementary Physics. Light and sound. Lecture demonstrations and recitations. Second term (3).

326. Physical Laboratory. Electricity, magnetism, light and sound. Preparation required: 322, 323, 324. Fee, $6. Second term (1).

327. Advanced Theory of Electricity and Magnetism. Lectures and recitations. Ferro-magnetism, electro-magnetism, induced electromotive force and inductance, magnetic properties of iron, electric charge and the condenser, electric field, potential, electric oscillation and waves, electron theory, electrolysis. Pre-requisites, differential and integral calculus and course 323. First term (2).

328. Electrical Laboratory. Precise measurements. Preparation required: 322, 323, 324, 326. Fee, $6. First term (1).

329. Electrical Laboratory. Precise measurements. Continuation of 329. Fee, $6. Second term (1).

330. Electrical Laboratory. Advanced experimental studies and tests. Continuation of 320. Fee, $6. First term (1).

Courses 320 to 330, inclusive, are intended primarily for students in the College of Engineering.

331. Elementary Physics. A brief general course. Lecture demonstrations, recitations and laboratory. First term (3). Second term (3).

332. Modern Physics. A non-mathematical account of the modern views concerning such subjects as the Nature of Matter, Radio-activity, X-rays, etc. First term (2). Second term (2).

333. Introduction to Theoretical Physics. Mechanics, Thermodynamics, the Kinetic Theory of Gases, the Wave Theory of Light and the Mathematical Theory of Electricity and Magnetism. Preparation required, course 331, and differential and integral calculus. First term (3). Second term (3).

334. Laboratory Physics. A laboratory course of advanced character to accompany course 333. The experiments, in general, are designed to encourage originality on the part of the student. Fee, $6 per term. First term (2). Second term (2).

335. Physical Optics and Spectroscopy. Elementary treatment of the Wave Theory of Light, Interference, Diffraction, Polarization, etc. Exposition of some phases of spectroscopic phenomena. First term (3).

336. Electric Discharges Through Gases. The properties of gaseous ions, the experimental data leading to the Electron Theory, including a study of vacuum tube phenomena. Ionization and Resonance Potential, Photo-electricity, etc. Second term (3).

337. Laboratory Physics. A continuation of course 334 to accompany courses 335 and 336. Fee, $6 per term. First term (2). Second term (2).

Courses 331 and 332 are designed to meet the requirements in Physics for students in the College of Arts and Science and for students taking the Pre-Medical Course.

Courses 333 to 337 are designed for students in the College of Arts and Science who elect Physics as their major subject.

338. Photometry and Illumination. Lectures and recitations. Illumination standards, measurements of light and of illumination, laboratory methods and devices, commercial methods and experiments, comparison of illuminants and illuminating devices, practical installations. First term (1).

339. The Teaching of Physics in Secondary Schools. Principles of scientific method. A study of class room practice in neighboring schools. Text-books and methods. First term (2).

340. Telegraphy. Practice in sending and receiving the Morse and International Codes based upon Western Union and U. S. A. Signal Corps practice. First term (1). Second term (1).

ELECTRICAL ENGINEERING

PROFESSOR ESTY, ASSOCIATE PROFESSORS SEYFERT AND SCHEALER, ASSISTANT PROFESSORS BEAVER, GRUBER AND ESHBACH, MR. MILLER

351. Electrical Distribution. Systems of direct current distribution; wiring formulas and applications; installation of electrical machinery and apparatus; interior wiring; overhead and underground construction; rules and regulations of the National Board of Fire Underwriters. First term (2).

352. Dynamos and Motors. Review of principles of electricity and magnetism with special reference to their application to the dynamo. The construction, operation and control of direct current machinery; practical operation and management of dynamo machines; station equipment; cost of electrical energy; electro-magnets, magnetism of iron; characteristic curves, armature windings. Illustrative problems. Preparation required: 323, 324. Second term (3).

353. Dynamo Laboratory. Introductory course supplementing the class work of 352. Experimental studies and tests of direct current generators, motors, and appliances, for characteristics, regulation, efficiency, insulation, etc. Fee, $6. Preparation required: 323, 324. Second term (1).

354. Dynamos and Motors. An abbreviated course adapted to those students who do not continue this subject in the following year; the principles and practice of direct current engineering, including: the elementary theory, construction, operation and control of direct current generators and motors, electromagnets, solenoids, automatic starters and controllers, station equipment, storage batteries. Illustrative problems. Preparation required: 323, 324. First and second terms (2).

355. Dynamo Laboratory. Introductory course supplementing the class work of 354. Experimental studies and tests of direct current generators and motors for characteristics, regulation, efficiency, etc. Fee, $6. Preparation required: 323, 326. First and second terms (1).

356. Dynamo Laboratory. Continuation of 355 and supplementing the class work of 361 or 375. Advanced testing of direct current machines; practice in operating and testing alternating current apparatus. Fee, $6. Preparation required: 355, 354. First and second terms (1).

357. Theory of Alternating Currents. The elementary principles of alternating currents. Lectures, recitations and problem work. Preparation required: 352, 326. First term (3).

358. Dynamo Laboratory. Continuation of 353. Advanced testing of direct current machines. Fee, $6. Preparation required: 352, 353. First term (1).

359. Theory of Alternating Currents. Continuation of 357. Advanced theoretical studies of alternators, synchronous motors, and synchronous converters. Preparation required: 357. Second term (2).

360. Electrical Engineering. Application of physical and mathematical principles to the analysis and solution of problems relating to direct and alternating current circuits and apparatus; transient phenomena, use of complex quantities; non-harmonic periodic wave forms. Preparation required: 327, 357. Second term (3).

361. Electrical Engineering. A course particularly adapted to students who do not further specialize along electrical lines; systems of generation, transformation, distribution and transmission of electrical energy by direct and alternating currents;

the application of electric motors to various industries; overhead and underground construction; estimates and costs. Preparation required: 354, 355. Second term (2).

362. Dynamo Laboratory. Continuation of 356 or 358. Advanced testing of direct current machines. Alternating current testing begun. Fee, $6. Preparation required: 357, 358. Second term (1).

363. Alternating Current Machinery. Study of the structural details, characteristics and operation of alternators, alternating current motors, rotary converters and transformers; application of vectors. Preparation required: 327, 359, 360. First term (4).

364. Dynamo Testing. Lectures on the methods of testing electrical machinery and apparatus, including direct current generators, motors and motor generator sets. Special methods of testing large machines; commercial tests as carried out by the large manufacturing companies. Preparation required: 327, 357, 358. Second term (1).

365. Dynamo Testing. Continuation of 364. Lectures on testing of alternating current machinery and apparatus, including generators, motors, rotary converters, transformers, induction regulators, etc. Preparation required: 359, 364. First term (1).

366. Dynamo Laboratory. Advanced experimental studies and tests of direct and alternating current generators and motors, synchronous converters, transformers and auxiliary apparatus; measurement of power in polyphase circuits. Fee, $12. Praparation required: 359, 360, 362. First term (3).

367. Electrical Design. Application of electric, magnetic and mechanical principles to the design of electromagnetic mechanisms, direct current generators and motors; predetermination of characteristics and performance; armature windings. Lectures, recitations, problems, drafting. Preparation required: 359, 360, 362. First term (2).

368. Electric Stations. Consideration of prime movers; generating machinery, discussion of types and operation; auxilliary machinery and transformers; storage batteries and their application; switch-boards, measuring and protective devices; design and arrangement; station characteristics; sub-

stations; operation and management; visits to neighboring plants. Preparation required: 359, 362. First term (2).

369. Electrical Engineering Seminary. A weekly meeting held in the department reading room for discussion of topics from the current journals of theoretical and applied electricity. Presentation of papers on assigned topics; new inventions and discoveries critically reviewed. Preparation required: 357, 360. First term (1).

370. Electrical Design. Continuation of 367. Application of electric, magnetic and mechanical principles to the design of alternating current machinery and apparatus; predetermination of characteristics and performance; armature windings. Lectures, recitations, problems, drafting. Preparation required: 363, 366, 367. Second term (2).

371. Electric Traction. Optional with 378. The construction, equipment and operation of different types of electric railways. The application of electric traction under steam railroad conditions; the dynamics of electric train movements; predeterminations of speed-time curves and the power required for different types of runs. Choice of car equipment; cost of construction and of operation. Testing of railway systems. Visits of inspection to power plants and required reports. Preparation required: 363, 368. Second term (3).

372. Electric Power Transmission. The long distance transmission of power by electricity for use in lighting, traction, mining and manufacturing work. Mathematical determination of line constants, regulation, interference, transients, etc. Switching and protection of circuits; metering and methods of charging for power; recent practice in design and construction of lines and systems. Preparation required: 375 or 363, 368 or 361. Second term (3).

373. Electrical Engineering Seminary. Continuation of 369. Presentation and discussion of reports on thesis work. Preparation required: 369. Second term (1).

374. Dynamo Laboratory. Continuation of 366. Advanced alternating current testing. Fee, $12. Preparation required: 363, 365, 366. Second term (2).

375. Alternating Currents. A course following course 354; the principles and practice of alternating current engineering; the theory of alternating currents with applications to alternating current generators, motors, transformers and other apparatus; systems of transmission and distribution; electric lighting. Preparation required: 354. First and second terms (2).

376. Inspection Report. During the vacation between the Junior and Senior years each student in Electrical Engineering is required to inspect some electric railway system, lighting or power plant, or other electrical installation, and prepare a written report thereon. A descriptive outline of the installation which the student proposes to inspect must be submitted to the Professor of Electrical Engineering before July 5th, and after approval the detailed report must be handed in before September 20th. These reports should contain such calculations, photographs, drawings and plots as each individual case may require.

377. Thesis for Degree of E.E. Each candidate for the degree of Electrical Engineer is required to present a thesis upon a subject chosen by the candidate during the first term of the Senior year. The work upon which the thesis is based is done during the second term, and it consists in part of reading from references furnished by the professor in charge, and in part of independent work in theory, experimental research, or designing. Reports of progress on thesis work are required from time to time during the term. Much importance is attached to the thesis as evidence of the candidate's ability to carry out an independent investigation. Second term (3).

378. Electrical Communication. Optional with 371. A survey of the methods of electrical ocmmunication, principles of various systems of wire telegraphy, wire telephony, radio telegraphy and telephony, radio laboratory measurements, radio practice of the U. S. Signal Corps. Fee, $6. Preparation required: 357 or 375. Second term (3).

CHEMISTRY

PROFESSORS ULLMANN AND BABASINIAN,
ASSOCIATE PROFESSORS DIEFENDERFER, CHAMBERLIN AND LONG,
ASSISTANT PROFESSORS BECK, EWING, CARTER, ANDERSON,
AND OPDYCKE, MESSRS. BUCKLEY, CANTELO AND SMULL

390. ELEMENTARY CHEMISTRY. Description of the non-metallic and metallic elements and their compounds. Lectures illustrated by experiments, diagrams, working drawings and specimens from the museum. Note-books on the lectures required. First term (2).

391. CHEMISTRY LABORATORY. Experiments covering a systematic study of the chemical and physical properties of the more important elements and their compounds. Long and Chamberlin's *Experimental General Chemistry.* Deposit, $15. First term (2).

392. CHEMISTRY LABORATORY. For B.A. students. Shorter course than course 391. Deposit, $15. First term (1).

393. CHEMISTRY. A course for students who pass the examination in Elementary Chemistry held on the first Saturday of the term. Smith's *Intermediate Chemistry for Colleges.* First term (2).

393a. CHEMISTRY LABORATORY. Experiments designed to accompany 393. Deposit, $15. First term (2).

394. CHEMISTRY. Continuation of 390 and 393. Second term (1).

395. QUALITATIVE ANALYSIS. Practical work in the qualitative laboratory, accompanied by lectures and recitations. Treadwell's *Analytical Chemistry, Vol. I.* Deposit, $25. Second term (2) or (3).

396. QUALITATIVE ANALYSIS CONFERENCE. Special consideration of science underlying qualitative analysis. Second term (1).

397. STOICHIOMETRY. Chemical problems and reactions. Long and Salisbury's *Chemical Calculations.* Second term (1).

398. ADVANCED CHEMISTRY. Lecture course, with recitations. Theories of chemistry; physical and chemical methods of determining atomic and molecular weights, thermo-chemistry, dissociation, solution, catalysis, electrolysis, radio-activity, non-metallic elements and their compounds. Preparation re-

quired: 390 or 393, 391, 397. Mellor's *Modern Inorganic Chemistry*. First term (3).

399. Advanced Chemistry. Lecture course, with recitations. Phase rule, solid solutions, colloid chemistry, metallic elements and their compounds. Preparation required: 398. Mellor's *Modern Inorganic Chemistry*, Gulliver's *Metallic Alloys*. Second term (3).

400. Quantitative Analysis. Practical work in the quantitative laboratory, accompanied by lectures and recitations. Acidimetry, alkalimetry, chlorimetry, and the determination and analysis of simple chemical compounds and ores. Treadwell's *Analytical Chemistry, Vol. II*. Deposit, $30. First term (3).

401. Quantitative Analysis. Practical work in the quantitative laboratory. Analysis of simple chemical compounds, ores and metallurgical products. Deposit, $25. First term (3).

402. Quantitative Analysis Conference. Lecture and recitations concerning the laboratory work of 400 and 401. First term (2) or (1).

403. Quantitative Analysis. Continuation of 401. Deposit, $30. Second term (3).

403a. Quantitative Analysis. Summer course arranged for students in Metallurgy. Deposit, $40. Summer term (3).

404. Quantitative Analysis. Continuation of 400. Analysis of minerals, ores, slags, alloys, electrolytic analysis, etc. Treadwell's *Analytical Chemistry, Vol. II*. Deposit, $30. Second term (2) or (3).

405. Quantitative Analysis Conference. Lectures and recitations concerning laboratory work of 403 and 404. Second term (2) or (1).

406. Quantitative Analysis. Continuation of 404. Ores and alloys, complete analysis of iron and steel; also gas analysis, mineral water analysis, etc. Treadwell's *Analytical Chemistry, Vol II*, Lord and Demorest's *Notes on Metallurgical Analysis*, Hempel's *Gas Analysis*. Deposit, $25. First term (2).

407. Quantitative Analysis Conference. Discussions concerning the laboratory work of 406. First term (2) or (1).

408. Organic Chemistry. Lectures and recitations. Typical compounds of carbon, their classification, general relations, and methods of preparation of important compounds. Bernthsen's *Organic Chemistry*, translated by Sudborough. First term (3).

409. Organic Chemistry Laboratory. Determinations of specific gravities, melting points, boiling points, vapor densities; qualitative and quantitative determinations of carbon, hydrogen, nitrogen, and the halogens. Preparation of pure organic compounds. Gattermann-Schober's *Practical Methods of Organic Chemistry*, Cohen's *Practical Organic Chemistry*. Deposit, $20. First term (2).

410. Organic Chemistry. Continuation of 408. Lectures and recitations. Second term (4).

411. Organic Chemistry Laboratory. Continuation of course 409. Practical methods of saturation, nitration, reduction, diazotization, sulphonation, etc. Preparation of pure compounds. Study of the properties of dyes and other commercial products. Gattermann-Schober's *Practical Methods of Organic Chemistry*, Cohen's *Practical Organic Chemistry*. Deposit, $40. Second term (3) or (2).

411a. Advanced Organic Chemistry. Satisfactory completion of courses 408, 409, 410, 411 is a prerequisite. First term (2).

412. Industrial Chemistry. Engineering fundamentals, including machinery and materials of chemical plants, transportation of gases, liquids and solids, grinding, pulverizing, screening, filtration, evaporation, distillation, etc. Laboratory work includes the application of these fundamentals, with reports on various problems of chemical engineering. Deposit, $25. First term (3).

413. Assaying. Lectures and laboratory practice in the furnace assay of the ores of lead, tin, gold, silver and of gold and silver bullion. Cyanidization. Calculations for slag and slag mixtures. Lodge's *Notes on Assaying*. Deposit, $30. Summer term: four weeks, beginning June 13, 1923, (3).

414. Assaying and Industrial Mineralogy. This covers much of the ground of 413. In addition there is instruction and laboratory work in Industrial Mineralogy, embracing about seventy-five minerals and rocks. It is intended primarily for students in Chemistry and Chemical Engineering. Deposit, $30. Summer term, four weeks, beginning June 13, 1923, (3).

415. Industrial Chemistry. Continuation of 412. Lectures, problems and inspection trips on chemical processes and industries. Second term (3).

416. Industrial Analysis. Analysis of commercial products. Laboratory work. Allen's *Commercial Organic Chemistry*. Deposit, $10. Second term (3).

417. Industrial Analysis Conference. Lectures concerning the laboratory work of 416. Second term (1).

418. Sanitary Chemistry Laboratory. Qualitative and quantitative examination of drinking water and food-stuffs. Deposit, $15. Second term (1).

419. Physical Chemistry. Lectures and recitations. Lewis' *A System of Physical Chemistry*. First term (3).

420. Physical Chemistry Laboratory. Physico-chemical measurements. Findlay's *Practical Physical Chemistry*. Deposit, $10. First term (1).

421. Physical Chemistry. Continuation of 419. Second term (2).

422. Physical Chemistry Laboratory. Continuation of 420. Deposit, $10. Second term (1).

423. Research Chemistry. Advanced stage of study or an investigation approved by the Professor of Chemistry of some novel problem, involving exhaustive laboratory and library study. Deposit, $15. First term (2) or (3).

424. Research Chemistry Laboratory. Continuation of 423. Deposit, $15. Second term (2).

425. History of Chemistry. Chronological development of the science, with assigned reading. Second term (1).

Deposits to cover breakage, chemicals, etc., are required as indicated above. The unused portion of the deposit is returned to the student.

Summer Schools. A course in Quantitative Analysis begins July 16, 1923, and continues for four weeks. The required course in Assaying and Industrial Mineralogy (414) begins June 13, 1923, and a second course may be given later. Summer courses are open to all persons prepared to take them.

SHIP CONSTRUCTION AND MARINE TRANSPORTATION

PROFESSOR CHAPMAN, MR. CLARK

450. Ship Construction. One recitation and one drawing period a week. A study of the construction of modern steel ships. The class-room work is paralleled by drawing-room

exercises, where the student works up a number of construction drawings based on the rules of the Registration Societies. Full treatment given to both longitudinal and transverse types of construction. Holms' *Practical Ship Building.* First term (2).

451. SHIP CONSTRUCTION. A continuation of course 450, taking up details of ship construction, bow and stern construction, and special types of construction. During the courses 450 and 451 the student fairs a set of ship's lines. Second term (4).

452. NAVAL ARCHITECTURE. Displacement, stability, trim launching and strength of ships. Class room work paralleled by calculations in the drawing room. A displacement sheet worked up, a curve of statical stability calculated by use of the integrator, and launching calculations carried out. Course illustrated by numerous practical problems. Preparation required: 147. First term (3).

453. NAVAL ARCHITECTURE. Resistance, powering and propulsion; steering and maneuvering; and rolling of ships. A study made of the effect of size, form and coefficients on the speed and power of ships; appendage resistance, models and model tanks; powering of paralleled bodied ships; propeller design and the influence of the hull on the action of the propeller. The work in rolling takes up a mathematical investigation of the rolling of ships in still water and among waves. Taylor's *Speed and Power of Ships.* Preparation required: 452. Second term (4).

454. MARINE ENGINEERING. The marine power plant and the layout of machinery on shipboard. Boilers, reciprocating steam engines, turbines, combination machinery, electric drive, and Diesel engines; fuels, combustion, draft and draft apparatus; condensing apparatus and ship auxiliaries. Chapman's *The Marine Power Plant.* Preparation required: 218. Second term (4).

455. SHIP DESIGN. Lectures and drawing-room work. In this course and course 456 each student carries through a design for assigned requirements which parallels the class-room work. In this design he works up the dimensions, coefficients, displacement, estimated weights and lines; stability under various conditions of loading; power and propeller requirements; layout of the power plant; freeboard and bulkhead subdivisions as

required by law; strength calculation; and cargo handling arrangements. Lectures covering the design of boats for inland water navigation. Preparation required: 450 to 454. First term (3).

456. Ship Design. A completion of the work of course 455. Lectures covering tonnage, flooding of compartments and some of the economic aspects of ship design and operation. Preparation required: 455. Second term (3).

457. Terminal Facilities. A study of the loading and unloading of ships, cranes, piers, transit sheds, warehouses and railroad facilities and the other factors involving a quick "turn-around" of a ship in port. MacElwee's *Ports and Terminal Facilities.* Second term (2).

458. Summer Work in Ship Construction and Marine Transportation. During the summer following the Sophomore and Junior years, students are required to spend at least eight weeks in a shipyard or at sea. (3).

459. Ship Operation. A study of the engineering aspects of ship operation. The relation of size and speed of ships for the most economical performance in service; a study of the operating expenses of ships with different types of propelling machinery on various trade routes; influence of stevedoring costs and turn-around on profits; comparison of operating expenses of the steamship and the motor ship. Numerous practical problems. Preparation required: 454 and 455. Second term (2).

MILITARY SCIENCE AND TACTICS

MAJORS LANG AND PATCH, CAPTAINS SHAMOTULSKI, BELL, BALDWIN, HOLLINGSWORTH, LIEUTENANT GRAHAM, SERGEANTS MADDEN, LAVIN, ALDERSON, BOYLE

An infantry unit of the Reserve Officers' Training Corps was established at Lehigh University in September, 1919. Conducted on a voluntary basis during the year 1919-1920, the unit had a membership of 313 students. A year later the Trustees and Faculty of the University made Military Science and Tactics a required subject, under the R. O. T. C. regulations, for physically fit Freshmen and Sophomores. Provision for this training is made in their schedule of study.

The military courses contemplated under the War Department regulations consist of two years of basic work and two years of elective advanced work along specialized lines. A student taking the courses for four years becomes eligible, upon graduation, for a commission in the Officers' Reserve Corps of the United States Army. Uniform and equipment, consisting of cap, coat, shirt, breeches, leggins, rifle, belt, and bayonet, are furnished by the Government. Musical instruments are also furnished to the members of the band. Each student having in his possession any government property is required to execute a bond for $50. During the advanced course students are paid commutation of subsistence, amounting to approximately $10 a month.

470. Basic Course. Fundamental military training common to all arms of the service. Three hours a week, two theoretical and one practical. Theoretical instruction consisting of lectures, recitations, and quizzes on organization, infantry drill regulations, rifle markmanship, scouting and patrolling, physical training and military courtesy. Practical instruction given in infantry drill, target practice and ceremonies. First and second terms (1½).

470a. R. O. T. C. Basic Camp of six weeks, with report, for engineering students, except Naval Engineers (3).

471. Basic Course. Second year. Three hours a week. Fundamental military training common to all arms. Fundamentals of map reading and military sketching, military hygiene, musketry, sanitation and first aid, command and leadership, automatic rifle, bayonet, and grenades. First and second terms (1½).

472. Advanced Course. Third year. Five hours a week. Field engineering, 37 mm. gun, light (Stokes) mortar, machine guns, military law, rules of land warfare, command and leadership, drill, marches, concealment and camouflage. First and second terms (3½).

472a. Summer R. O. T. C. Advanced Camp (3).

473. Advanced Course. Fourth year. Five hours a week. infantry drill, tactics, tactical walks, war games, military history of the United States, command and leadership, pistol markmanship, interior economy, and administration. First and second terms (3½).

Ample facilities for close order drill are afforded on Taylor Field. A twelve target, fifty and seventy-five foot, indoor range is located in the cage. A five target, fifty foot, range is located in Packer Hall basement; on the Mack Farm property is a four target outdoor range with firing points at 200, 300 and 500 yards. Intercollegiate team matches and intramural team matches are held from December 1 to May 1, both indoors and outdoors.

PHYSICAL EDUCATION

PROFESSOR REITER, ASSOCIATE PROFESSOR BALDWIN, ASSISTANT PROFESSOR BARTLETT, MR. KANALY

The aim of the Department of Physical Education is to insure the health and physical development of every student of the University. Exceptional facilities for accomplishing this aim are afforded in Taylor Gymnasium, field house and the two playing levels of Taylor Field.

Each student, upon entering the University, is given a physical examination by the Department and also a medical examination by the consulting physician. He receives a plotted card showing his relation to the normal student and he is advised as to postural and physical defects. A second physical examination later is offered, to afford evidence of improved condition.

All students are required to take regular exercise under Department supervision. This requirement calls for two hours a week in the gymnasium, or participation, under the oversight of the Director, in one of the following organized sports: football, cross country running, basketball, wrestling, swimming, soccer, track, lacrosse, tennis and baseball. Members of the R. O. T. C. unit may substitute one hour of military drill for one of the two hours of required gymnasium.

500. GYMNASIUM. Class exercise in the open air, consisting of setting up work for current carriage. Work with dumb bells, wands, and Indian clubs to stimulate circulation, respiration, muscular action and to produce co-ordination and grace. Squad work on the heavy apparatus to develop strength in the larger muscles; recreative work in games and competitive exercises, to develop the play and combative elements. The various drills and athletic dances accompanied by music.

Instruction in boxing, wrestling and swimming. The swimming course includes the various swimming strokes, fancy diving and modern methods of life saving. A competent instructor is in charge. The measure of proficiency required of every student is swimming at least the length of the pool. Voluntary classes in advanced apparatus work. Talks given to the Freshmen on personal hygiene and the physiology of exercise. First and second terms; for Freshmen, Sophomores, (½), Juniors, Seniors, Graduate Students, (1).

CONFERENCE DEPARTMENT

PROFESSORS LAMBERT, PALMER, ULLMANN AND MAC NUTT

The Conference Department provides extra instruction in Mathematics, Modern Languages, Physics, and Chemistry for Freshmen and Sophomores.

Any student who wishes to clear up some difficulty in the Mathematics, Modern Languages, Physics, or Chemistry of the Freshman or Sophomore year, should consult the teachers in the Conference Department. Students may report at 7 o'clock any evening except Saturday. There is no fee for instruction in the Conference Department.

EXTENSION COURSES

The extension courses of the University are of collegiate grade. Below is the list of such courses offered. All courses marked "G" may be offered by graduate students toward the higher degrees; courses marked "g" may be so offered under conditions prescribed by the department offering the course, and with the express consent of the Committee on Graduate Courses. The letter "e" is used to indicate courses that are open to students not matriculated in the University.

PHILOSOPHY, PSYCHOLOGY AND EDUCATION

PROFESSOR HUGHES, ASSISTANT PROFESSOR DROWN

PHILOSOPHY. 1eg. HISTORY OF PHILOSOPHY. Leighton. (2) Evenings or Saturday.

PHILOSOPHY. 2e. THE RELIGION OF PHILOSOPHY. Plato, Spinoza, Kant, James. (2) Evenings.

PHILOSOPHY. 3e. ELEMENTARY LOGIC. Sellers. (2) Saturday A.M.

PHILOSOPHY. 4e. HISTORY OF SCIENCE. Libby. (2) Evenings.

PSYCHOLOGY. 1e. GENERAL PSYCHOLOGY. (2, 3 or 4) Afternoons.

PSYCHOLOGY. 2e. INTELLIGENCE. An introductory course in testing and developing intelligence. Dewey, Terman. (2) Evenings or Saturday.

PSYCHOLOGY. 3eg. MENTALITY OF SCHOOL CHILDREN. Advanced course in tests, surveys and clinical studies. (2) Evenings or Saturdays.

PSYCHOLOGY. 4eg. SOCIAL PSYCHOLOGY. Dewey, Wallas, (2) Evenings or Saturday.

EDUCATION. 1e. ELEMENTARY SCHOOL METHODS. (2) Evenings or afternoons.

EDUCATION. 2e. EDUCATIONAL MEASUREMENTS. The standard tests of achievement; how to use them. (2) Evenings or afternoons.

EDUCATION. 3eg. EDUCATIONAL MEASUREMENTS. Advanced course. Investigations and reports. (2, 3 or 4) Evenings, afternoons or Saturday.

EDUCATION. 4eg. THE PROJECT METHOD. Readings, reports, observation, experiment. (2 or 3) Evenings.

EDUCATION. 5 eg. SECONDARY EDUCATION. Introductory course. Colvin. (2) Evenings.

EDUCATION. 6eG. SECONDARY EDUCATION. Advanced course. Inglis, Monroe, Johnson. (2, 3 or 4) Evenings.

EDUCATION. 7eg. JUNIOR HIGH SCHOOL. Briggs, Douglas, and others. (2 or 3) Evenings.

EDUCATION. 8eg. SCHOOL ADMINISTRATION. Cubberly; State (2), City (2). Evenings or Saturday.

EDUCATION. 9eG. SEMINAR IN EDUCATION. Reports and discussions. Saturday.

EDUCATION. 10e. HISTORY OF EDUCATION. Rousseau's *Athens, the Renaissance;* American Schools, schools of today and of tomorrow. (3) Saturday or evenings.

EDUCATION. 11e. EDUCATIONAL SOCIOLOGY. (2) or (4) Evenings.

EDUCATION. 12e. CURRICULUM MAKING. (2) Evenings or Saturday.

ECONOMICS, PUBLIC LAW AND HISTORY

PROFESSOR STEWART, ASSISTANT PROFESSOR BROWN

ECONOMICS. 1eg. SOCIOLOGY. Sociological and economic theory, and problems to which this theory may be applied. (2)

HISTORY. 1e. INDUSTRIAL HISTORY OF THE UNITED STATES. Bogart's *Economic History of the United States;* Cressy's *Outline of Industrial History.* (2) Saturday.

HISTORY. 2eg. POLITICAL AND SOCIAL HISTORY OF MODERN EUROPE. Lectures and discussions. Special reference to the causes of the recent war. (2) Evenings.

LATIN

PROFESSOR WRIGHT

LATIN. 1e. A course corresponding to the work of the Freshman year in college. (2), (3) or (4). Evenings or Saturday A.M.

LATIN. 2eg. Advanced course in Latin Literature, suited to graduate students. Hour to be arranged.

FRENCH

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

FRENCH. 1e. ELEMENTARY FRENCH. (3) Evenings or Saturday A.M.

FRENCH. 2e. ELEMENTARY FRENCH, continued. Reading and conversation course. (3) Evenings or Saturday A.M.

FRENCH. 3eG. RECENT FRENCH LITERATURE. Investigation and discussion of phases of French life as exemplified in French literature; rapid reading. (3) Tuesday, Thursday, Friday, 3:30 to 6 P.M.

SPANISH

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

SPANISH. 1e. ELEMENTARY SPANISH. (3) Saturday A.M., on Tuesday, Thursday, Friday, 4:30 to 6 P.M.

SPANISH. 2e. ELEMENTARY SPANISH, continued. (3) Saturday A.M., or Tuesday, Thursday and Friday, 4:30 to 6 P.M.

GERMAN

PROFESSOR PALMER, ASSISTANT PROFESSOR MORE

GERMAN. 1e. ELEMENTARY GERMAN. German Grammar and Composition. Easy German Texts. (2) Saturday A.M.

GERMAN. 2e. INTERMEDIATE GERMAN. German Prose and Poetry. Heine, Keller, Meyer, Freytag, Storm, Heyse. (3) Saturday A.M.

GERMAN. 3e. Goethe's *Faust*, Part I, Lectures and Composition; or Nineteenth Century German Drama. (3) Saturday A.M.

GERMAN. 4eG. Goethe's Dramas, or Schiller's Life and Work, or Middle High German. (3) or (5) Afternoons, 4 to 6.

GERMAN. 5e. Teacher's Course in methods of teaching, discussion of text-books, phonetics of German, advanced German grammar and syntax, advanced composition. (2) Saturdays or afternoons.

ENGLISH

PROFESSOR LUCH, ASSISTANT PROFESSOR MESCHTER, MR. LAMBERT

ENGLISH. 1e. PUBLIC SPEAKING.

ENGLISH. 2e. CONTEMPORARY DRAMA.

ENGLISH. 3e. VICTORIAN LITERATURE.

ENGLISH. 4e. RHETORIC AND COMPOSITION.

ENGLISH. 5e. SHAKESPEAREAN DRAMA.

METALLURGY

ASSOCIATE PROFESSOR ROUSH, ASSISTANT PROFESSOR BUTTS

METALLURGY. 1e. GENERAL METALLURGY. (2) Evenings.

METALLURGY. 2e. METALLURGY OF IRON AND STEEL. (2) Evenings.

GEOLOGY

PROFESSOR MILLER, ASSISTANT PROFESSOR TURNER

GEOLOGY. 1e. GENERAL GEOLOGY. Lectures, field trips and laboratory. Study of geologic processes and results. (4) Saturday P.M.

GEOLOGY. 2e. GEOLOGY OF PENNSYLVANIA. Lectures, field trips and laboratory. Geological history of the State and its bearing on economic and political development. (4) Saturday P.M.

GEOLOGY. 3e. APPLICATIONS OF GEOLOGY to the teaching of Physical Geography. Illustrated lectures; discussion of school problems. (4) Evenings.

GEOLOGY. 4eG. The graduate courses listed on pages 143 and 144 may be pursued as extension courses by qualified students.

BIOLOGY

PROFESSOR HALL, MR. KREIDLER

BIOLOGY. 1eg. GENERAL BIOLOGY. Lectures, laboratory and discussions. (2), (3), (4) Saturday.

BIOLOGY. 2eg. COMPARATIVE ANATOMY. Lectures, laboratory and discussions. (2), (3), (4) Saturday.

BIOLOGY. 3eg. BACTERIOLOGY AND SANITARY BIOLOGY. Lectures, laboratory and discussions. (2), (3), (4) Saturday.

BIOLOGY. 4eg. EMBRYOLOGY. Lectures, laboratory and discussions. (2), (3), (4) Saturday.

BIOLOGY. 5eg. The graduate course listed on page 139 may be pursued as an extension course by qualified students. Afternoons, 4 to 6, or Saturdays.

BIOLOGY. 6eg. FORESTRY. Lectures, laboratory and discussion. (3) Saturday.

PHYSICS

PROFESSOR MAC NUTT,
ASSISTANT PROFESSORS FRAIM AND MARTIN

PHYSICS. 1e. ELEMENTARY PHYSICS. A brief general course; lectures, demonstrations, recitations and laboratory. (4) Saturday P.M.

ELECTRICAL ENGINEERING

PROFESSOR ESTY, ASSOCIATE PROFESSORS SEYFERT AND SCHEALER, ASSISTANT PROFESSORS BEAVER, GRUBER AND ESHBACH, MR. MILLER

CONSTRUCTIVE ELEMENTS OF ELECTRICAL APPARATUS. 1e. Studies of electrical machinery and appliances with the object of familiarizing the student with principles of operation, structural details, and practical uses. (2) Evenings.

ELECTROTECHNOLOGY. 2e. Review of the principles of electricity and magnetism, with special reference to their application to dynamo electric machinery; the elementary theory of direct current generators and motors; automatic starters and controllers; rates and costs; practical operation of dynamos; station equipment; storage batteries. DYNAMO LABORATORY. Experimental studies and tests of direct current generators and motors for characteristics, regulation efficiency, etc. Laboratory fee, $6, in addition to a charge of $15 for the course. (3) Evenings.

ELECTROTECHNOLOGY. 3e. Theory of alternating currents with application to alternating current machinery and alter-

nating current systems of transmissions, distribution and utilization; electric lighting. DYNAMO LABORATORY. Experimental studies and tests of alternating current generators and motors, synchronous converters, transformers, and auxiliary apparatus; measurement of power in polyphase circuits. Laboratory fee, $6, in addition to a charge of $15 for the course. (3) Evenings.

CHEMISTRY

PROFESSOR ULLMANN, ASSOCIATE PROFESSOR BABASINIAN

CHEMISTRY. 1e. ELEMENTARY CHEMISTRY, with laboratory. (2) or (4) Laboratory fee of $10, in addition to a charge of $10 for the single and $20 for the double course. A summer course only.

CHEMISTRY. 2e. ORGANIC CHEMISTRY. (2 to 4) Fee, $25, including laboratory. (3) or (4) Afternoon.

SUMMER SESSION OF EXTENSION COURSES

During the Summer of 1922 three of the fraternities upon the Campus were opened to extension students with good results. It is proposed, during the Summer of 1923, to open fraternities to women students, and to open a section of the dormitories to men students in the Extension Courses.

The following courses were given in 1922:

THEORY AND PRACTICE OF SPEECH CORRECTION	(6)
PSYCHOLOGY OF SPEECH CORRECTION	(2)
EDUCATIONAL PSYCHOLOGY	(4)
HISTORY OF PHILOSOPHY (Graduate)	(4)
MENTAL DIAGNOSIS	(4)
PRINCIPLES OF EDUCATION	(4)

The plans for the Summer session of 1923 have not yet been formulated. It is proposed to develop the laboratory studies to clinical and social phenomena that have been offered at the University for the past three years and thus to cooperate with the State Department in its efforts to promote the study of the social sciences in secondary schools.

Courses in several other departments of the University will be open to qualified students, including the departments of chemistry, geology, English, and modern languages.

The University Campus is a delightful place of residence, affording many opportunities of recreation, such as picnics,

tennis, etc. It stands well above the river, and offers beautiful views of the neighboring hills and plains. The dormitories and fraternities are dignified and convenient in all their appointments.

Those interested in Summer Courses at Lehigh University should address the Director of Extension Courses after February 1, by which time it is hoped that the new circular for Summer Courses will be ready.

EVENING SCHOOL OF BUSINESS ADMINISTRATION

The Lehigh University Evening School of Business Administration was organized in the fall of 1920 for business men in the vicinity of the University who desire a knowledge of the fundamental principles of the economics of business. A three-year course is offered. Instruction is given three evenings a week, from 7:40 to 9:40 o'clock, by members of the teaching staff of the College of Business Administration.

Upon completing the course a student receives a certificate of proficiency. If he later enters the College of Business Administration, his Evening School credits will be accepted on an hour for hour basis.

The subjects of the Evening School of Business Administration are as follows:

First Year

Business Law 1. Contracts and Negotiable Instruments. The principles of contract; formation of contracts; operation and discharge of contracts; sales of goods; insurance contracts; principal and agent; master and servant; negotiable instruments.

Banking and Currency. A study of the banking system of the United States, comparing it with those of the important European states, together with a study of the currency and currency problems of this country. Special emphasis upon the Federal Reserve Act.

Accounting. A study of the fundamental principles of accounting with sufficient practice work to illustrate these principles. Theories of debit and credit; single and double entry; construction of accounts; special books; distinction between capital and revenue and the problems involved; construction

and analysis of financial statements; equity accounts; valuation of assets; methods and problems of depreciation. Emphasis on the economy aspects of accounting.

ECONOMICS. Lectures on economics, supplementing the other work of the school; optional.

Second Year

BUSINESS FINANCE (2 Years). An exposition of the essential principles of sound financing; the different forms of financial organization; stocks and bonds; sale of securities, promotion and underwriting; financial management and irregularities and mismanagement.

LAW OF BUSINESS ORGANIZATION. A study of the various forms of business organization, as the single proprietorship, the partnership, and the corporation.

CORPORATION ACCOUNTING. The application of accounting principles to corporations, corporation accounts and records. The voucher system; construction and analysis of corporation statements and reports; assets of corporations and their valuation; capital stock and the stock books; bonds and other forms of indebtedness; distribution of profits; handling surplus and reserves; sinking and other funds; liquidation of a corporation; combinations and consolidations; branch house accounting. Considerable practice work. Problems selected largely from examinations for Certified Public Accountancy.

Third Year

(Three subjects to be chosen.)

AUDITING.
MANUFACTURING ACCOUNTS.
INDUSTRIAL ADMINISTRATION.
ECONOMICS.
LAW.
INVESTMENTS.
GOVERNMENT REGULATION OF BUSINESS.
ADVERTISING.
FOREIGN TRADE.
INSURANCE.

A circular giving entrance requirements, fees and other details may be obtained by addressing the Registrar of Lehigh University.

SUMMER TERMS

Summer courses are required as indicated in the foregoing schedules of courses. Students not connected with the University may be admitted to summer courses if properly qualified.

GRADUATE COURSES

Courses leading to the degree of Master of Arts or Master of Science may, by permission of the Faculty, be pursued by any properly qualified person who has taken the Bachelor's degree or a degree in technology at any recognized college, university or technical institution. These courses require at least one year of advanced study in residence at Lehigh University in two departments (under two professors), or at least two years of such study in non-residence. Residence is construed as continuous attendance at the University and living under its jurisdiction. Permission to enroll for study in non-residence will be granted only in exceptional cases to students who possess ample facilities for study and work and usually only to students who can report periodically in person for conferences with the professors under whom they are studying.

The course of study selected must consist of at least fifteen exercises a week. Two-thirds of the work, ten hours a week, including a thesis, if required, must be chosen in one department called the major department. The work in the major department is to be selected from the list of graduate studies. About one-third of the work is to be in another department, called the minor department, and may be chosen from the list of graduate studies or from other advanced courses offered by the University. In special cases, on recommendation of the Committee on Graduate Studies, a student may be permitted to take both major and minor courses in the same department provided the subjects are taken under two professors and are of distinctly different nature. The candidate is required to satisfy each professor concerned that he is fully competent to pursue the subjects selected.

Candidates may be enrolled at any period of the college year, but preferably at the beginning of the regular terms in September and February.

The fees for instruction are $100 a year for students in residence, and $50 a year for students in non-residence, payable in advance. Fees for students in residence are payable in two instalments of $60 and $40 at the beginning of the first and second terms respectively. A student in residence who takes

more than one year shall have returned to him a pro-rata part of his payment for the second, or other succeeding years, if he finishes in a fraction of that year. A student in non-residence shall pay for the first two years; no fee will be required for the third year, but succeeding years, if necessary and permitted by the Faculty, shall be paid for at the rate of $50 a year. The graduation fee of $10 is required of all students.

After passing examinations in the assigned studies, presenting a satisfactory thesis as evidence of ability to do original work, if required by the professor concerned, and paying all required fees, the candidate will be recommended by the Faculty to the Trustees for the Master's degree appropriate to the course pursued.

Some of the University Extension Courses listed on page 129 are designated as graduate courses. As these are given late in the afternoon, or in the evening, or on Saturdays, they are especially adapted to teachers and others who are enrolled as graduates in non-residence.

The following graduate studies are now offered by the University.

MATHEMATICS AND ASTRONOMY

PRACTICAL ASTRONOMY

PROFESSORS THORNBURG AND OGBURN

The study of instruments and methods used in the determination of time, latitude, longitude and azimuth; practical work in the observatory, securing facility in making and reducing observations. Two terms (5).

DIFFERENTIAL EQUATIONS

PROFESSOR LAMBERT

Course in Differential Equations based on Johnson's *Differential Equations* and Byerly's *Spherical Harmonics.* Collateral reading in the University Library required. Two terms (3).

ANALYTIC MECHANICS

ASSOCIATE PROFESSOR REYNOLDS

Elementary and Advanced Rigid Dynamics; Potential Functions, based on Love's *Theoretical Mechanics;* Williamson and Tarleton's *Dynamics;* and Routh's *Dynamics.* Two terms (3).

DIFFERENTIAL GEOMETRY

ASSISTANT PROFESSOR KNEBELMAN

Parametric representation of plane and skew curves and surfaces, theory of contact, curvature, differential invariants, intrinsic equations, trajectories, equations of Césaro, curvilinear coordinates, equations of Lamé. Representation of one plane upon another, conformal and spherical representation, equations of Gauss and Godazzi, theory of applicability. Two terms (2).

THEORY OF EQUATIONS

ASSOCIATE PROFESSOR STOCKER

An elementary and advanced course in Theory of Equations, based on the treatise by Burnside and Panton. Two terms (2).

INTEGRAL CALCULUS

ASSOCIATE PROFESSOR STOCKER

A course in advanced integral Calculus, including Elliptic Integrals, based on the works of Byerly and Williamson. Two terms (2).

ENGLISH

ENGLISH LITERATURE

PROFESSOR THAYER

An advanced course in branches which have not formed a part of the undergraduate work of the candidate, details to be arranged after a personal conference. Two terms (5).

ANGLO-SAXON

ASSISTANT PROFESSOR MESCHTER

Anglo-Saxon poetry and prose above the grade of undergraduate work, from both the literary and the historical points of view. Two terms (5).

ENGLISH PHILOLOGY

PROFESSOR LUCH

An advanced course in the principles of Teutonic philology as applied to the origin and development of the English language. Two terms (5).

MODERN POETRY

ASSISTANT PROFESSOR MESCHTER

Poetry of the Twentieth Century, in matter, metre and diction. Present tendencies. One term (5).

SANSKRIT

PROFESSOR THAYER

Beginner's Course. Perry's *Primer*. Lanman's *Reader*. Whitney's *Grammar*. Two terms (5).

ECONOMICS AND HISTORY

POLITICAL ECONOMY

PROFESSOR STEWART

The rise and development of economic systems and economic thought; the scope and method of political economy. Patten's *Development of English Thought* and the works of Keynes, Cohn and Ingram on political economy are used. Two terms (5).

FINANCE

Advanced course in Finance, with special reference to study of a financial system. Adapted to the peculiar requirements of the Federal and local government of the United States. Two terms (5).

AMERICAN HISTORY

PROFESSOR STEWART

An examination of the influence of the economic development of the Union upon the legal and political theories incorporated in the Constitution. Two terms (5).

POLITICS

PROFESSOR STEWART

The history of the attempt to treat in a systematic way the problems of political organization. Pollock's *History of the Science of Politics* and Sidgwick's *Elements of Politics*. Two terms (5).

ACCOUNTING AND BUSINESS FINANCE

ASSOCIATE PROFESSOR BICKLEY

AUDITING. Procedure in conducting an audit; detection of errors and defalcations; financial conditions of business as revealed by the accounts and other sources of information. The social and legal responsibilities of auditing. First and second terms (3).

COST ACCOUNTING. The various systems of manufacturing accounts for different types of manufacturing enterprises; choice of methods to meet peculiar needs; installing cost systems; forms and records; manufacturing accounts as an aid

to and as a check on production efficiency; preparation of reports for executives. First and second terms (3).

ACCOUNTING SYSTEMS. A study of the accounting systems of various types of business and other organizations. First and second terms (3).

ADVANCED ACCOUNTING PROBLEMS. This course covers the whole field of accounting and is based primarily on the requirements for the certified Public Accountant examination. The work consists largely of problems selected from certified Public Accountant examinations. First and second terms (3).

BUSINESS FINANCE. This course deals with the organization and financial problems of both large and small business enterprises, and with the factors that enter into the permanency of business organization. The course is intended to break down the division of business into subjects and to correlate the work of other courses in business and to serve as a focusing point for the specific application of business principles. First and second terms (3).

GREEK

Advanced courses, of which the following are specimens, will be arranged upon application:

HELLENISTIC GREEK

PROFESSOR GOODWIN

Gospel of St. Mark, Acts, and selected *Epistles of the New Testament*. Thayer's *Lexicon*. Blass's *Grammar of New Testament Greek*. Patristic literature. Collateral reading. Selections from Lucian. Two terms (5).

DRAMATIC POETRY

PROFESSOR GOODWIN

Several plays of Aeschylus, Sophocles, Euripides, and Aristophanes. Aristotle's *Poetics*. Collateral reading. Two terms (5).

GREEK PHILOSOPHY

PROFESSOR GOODWIN

Plato's *Republic* and other works. Aristotle, selections. Ritter and Preller's *Historia Philosophiae Graecae*. Zeller's *History of Greek Philosophy*, and other collateral reading. Two terms (5).

ELECTRICAL ENGINEERING

THEORY OF ALTERNATING CURRENTS AND ALTERNATING CURRENT MACHINERY

PROFESSOR ESTY

A course based upon the works of Arnold, Bedell and Crehore, Fleming, Steinmetz and Lawrence. Two terms (4).

ELECTRICAL DESIGN

PROFESSOR ESTY

A course consisting of predeterminations by calculation of the characteristics, regulations and performance of electrical machinery. Analysis and use of designing constants. Design of special machines. Two terms (3).

ELECTRIC TRACTION

PROFESSOR ESTY, ASSISTANT PROFESSOR ESHBACH

The development of an electric railway project. Design of station and distribution system. Operating characteristics of direct and alternating curent railway motors. Predetermination of motor equipment and run curves for given schedules and traffic. Choice of system. Estimates of costs. Two terms (3).

ELECTRICAL TESTING

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT

Special experimental research in electrical engineering; tests of the magnetic properties of iron and steel; investigation of the series single-phase alternating current motor; leakage reactance of induction motors; regulation of alternators; polyphase testing; electric railway testing. Two terms (3).

RADIO COMMUNICATION

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT

The theory underlying the various sending and receiving systems, and the propagation of electromagnetic waves, combined with experimental work in connection with the department's wireless equipment. Two terms (2).

MINING ENGINEERING

METHODS OF MINING

PROFESSOR ECKFELDT

The study of methods used in a given mining region, or in the production of a given class of material, with respect to conditions influencing choice of method and cost. Two terms (5).

MINING PLANT

PROFESSOR ECKFELDT

The determination of the efficiency of mining machinery of given types under varying conditions. Two terms (5).

ORE DRESSING PLANT

ASSOCIATE PROFESSOR BARTLETT

The study of certain operations incident to the dressing of ores or the preparation of coal. Determination of efficiency of machines and processes. Losses in dressings. Two terms (5).

GERMAN

PROFESSOR PALMER, ASSISTANT PROFESSOR MORE

The German Drama of the Nineteenth Century. First and second terms (3).

Lessing as Dramatist and Critic. First and second terms (3).

Middle High German. Wright's *Middle High German Primer*, Bachmann's *Mittelhochdeutsches Lesebuch*, Nibelungenlied. First term (3).

Middle High German. Gudrun, Wolfram von Eschenbach, Gottfried von Strassburg, Walter von der Vogelweide. Lectures on Middle High German literature. Second term (3).

GEOLOGY

GEOLOGICAL INVESTIGATION

PROFESSOR MILLER

The investigation and study of the literature of some special geological problem. Field and laboratory work on some district; map of a limited area; an investigation of the microscopic character and general structural features of the rocks which are exposed; presentation of a thesis or dissertation embodying these results. Preparation required dependent upon the nature of the problems to be studied. Two terms (4).

ECONOMIC GEOLOGY

PROFESSOR MILLER

Advanced work in ore deposits. Study of the literature and of the theories of ore deposition, together with detailed work

on the type occurrences of some of the metallic or non-metallic minerals. Thorough investigation and report on some mining district with special regard to the origin of the ores and such commercial aspects of the deposits as may depend chiefly on the geology. Preparation required: 270 or 271. Two terms (6).

PETROGRAPHY

ASSISTANT PROFESSOR TURNER

A critical study of recent advances in petrographic methods and nomenclature. Preparation of a detailed report on a selected problem. Preparation required: 266, 268, 269 and 276. Second term (3).

PHYSIOGRAPHY

PROFESSOR MILLER

The detailed study of physiographic types and processes. Conferences, reports and thesis, with work in the laboratory and field. A training in elementary physiography and general geology required as a pre-requisite. Two terms (4).

PHYSICAL CRYSTALLOGRAPHY

ASSISTANT PROFESSORS TURNER AND FRETZ

An advanced course in the geometrical and physical properties of crystals, with special reference to the Goldschmidt methods of crystal measurement and projection. First term (4).

BIOLOGY

PROFESSOR HALL

Advanced courses, of graduate grade, may be arranged in comparative anatomy, vertebrate embryology and bacteriology. Other courses, covering such subjects as the history of biology, genetics, etc., which do not involve laboratory work, may also be arranged.

VERTEBRATE HISTOGENESIS AND ORGANOLOGY

Careful following, in the laboratory, of the development of a vertebrate, tracing of the history of the germ-layers, organs and tissues. Organology dealing with the association of tissues to form organs. Preparation required: 292, 293, 294. First term (3).

PHILOSOPHY, PSYCHOLOGY AND EDUCATION

PROFESSOR HUGHES, ASSISTANT PROFESSOR DROWN

The following undergraduate courses may count toward an advanced degree provided additional work is taken in connection with them: History of Philosophy, ancient and modern, History of Education, Educational Psychology, Problems of Secondary Education. More advanced courses in Psychology, Logic, Ethics and Metaphysics may be outlined to meet the needs of competent students.

The following is the course that commonly is followed by those who select Education as the major study. Educational Psychology, two year hours; School Administration, two year hours; Secondary Education, two year hours; Seminar in Education, with Thesis, four year hours. Most students in the field of Education find it convenient to avail themselves of the Extension Courses, which are listed on page 129.

GRADUATE COURSES

1. History of Philosophy, advanced course. (3)
2. Plato. More's Platonism and the Religion of Plato. (3)
3. The Philosophy of History. Augustine, Kant, Hegel, Comte, Spencer, Wells. The economic interpretation of history. The meaning of evolution. (4)
4. The Theistic Argument. (2)
5. Thesis in Philosophy. (2 to 5)
6. Educational Psychology. (2 to 5) Offered only as a minor.
7. Social Psychology. (2 or 4)
8. Educational Measurements. (2 or 4)
9. Secondary Education. (2 or 4)
10. School Administration; State and County. (2)
11. School Administration; City. (2)
12. Educational Sociology, advanced. (2)
13. Junior High School. (2)
14. Curriculum Making. (2)
15. Project Method. (2)
16. Seminar and Thesis in Education. (2 to 5)

Students who elect a major in this department will so arrange their course that some part of their work will be conducted under the second professor in the department.

FRENCH

LITERATURE

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

An advanced course in French Literature. The course is arranged with each candidate individually upon application. Two terms (5) or (10).

LANGUAGE

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

A. Old French. Grammar. Easier texts. Chanson de Roland. First or second term (2) or (3).

B. Old French. Reading and explanation of texts. First or second term (2) or (3).

C. Romance Philology. Sound change. Word formation. First or second term (2) or (3).

D. Romance Philology. Syntax. First or second term (2) or (3).

SPANISH

LITERATURE

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

An advanced course in Spanish Literature. First or second term (2) or (3),

LANGUAGE

PROFESSOR FOX

Old Spanish. Grammar. Readings. First or second term (2) or (3).

ITALIAN

PROFESSOR FOX

Dante's *Inferno*. Lectures and outside reading. First or second term (2) or (3).

CHEMISTRY

INDUSTRIAL CHEMISTRY

PROFESSOR ULLMANN, ASSOCIATE PROFESSOR CHAMBERLIN

Study of some industry dependent upon chemical principles, consisting of experimental and analytical work in the laboratory and study of the technical journals and other publications. Two terms (10).

ORGANIC CHEMISTRY

PROFESSOR BABASINIAN

Original investigations in organic chemistry. Two terms (10).

ANALYTICAL CHEMISTRY

PROFESSOR ULLMANN, ASSOCIATE PROFESSOR DIEFENDERFER

Study and comparison of known methods of quantitative analysis and the development of new methods. Two terms (10).

INORGANIC CHEMISTRY

ASSOCIATE PROFESSOR LONG, ASSISTANT PROFESSOR OPDYCKE

Original investigations in inorganic chemistry. Two terms (10).

PHYSICAL CHEMISTRY

ASSISTANT PROFESSOR EWING

Original investigations in physical chemistry. Two terms (10).

PHYSICS

THEORETICAL PHYSICS

PROFESSOR MAC NUTT,

ASSOCIATE PROFESSOR FRY, ASSISTANT PROFESSOR KLEIN

HEAT AND THERMODYNAMICS. The aim of this course is to present a comprehensive account of the Science of Heat and to develop the consequences of the two fundamental laws of Thermodynamics. First and second terms (3) to (5).

THE THEORY OF ELECTRICITY AND MAGNETISM. An introductory discussion of the theorems in electrostatics of Gauss, Poisson, Laplace, and their applications. Maxwell's theory of the electro magnetic field and electro magnetic waves followed by the Electron Theory of Lorenz as applied to Electricity and Magnetism. First and second terms (3) to (5).

THE THEORY OF LIGHT. This course is based upon the works of Preston, Drude, Wood, etc. First and second terms (3) to (5).

PHYSICAL RESEARCH

PROFESSOR MAC NUTT, ASSISTANT PROFESSOR KLEIN

Opportunity afforded advanced students to pursue experimental investigations in physics. First and second terms (2) to (4).

CIVIL ENGINEERING

BRIDGE DESIGN

PROFESSOR FOGG

The theory of suspension and arched structures, with the preparation of general plans and estimates, and the economic comparison of different types. Two terms (4).

TESTING OF MATERIALS

PROFESSOR FOGG, ASSISTANT PROFESSOR FULLER

The properties of materials of construction, with special reference to inspection and testing. Original researches by the student in the laboratory. Detailed attention to the work on the unification of methods of testing done by the International Association for Testing Materials. Two terms (5).

RAILROAD ENGINEERING

PROFESSOR WILSON

The economic location of railroads, as influenced by probable volume of traffic and cost of operation. A course based on Wellington's treatise, with detailed discussion of special cases. Two terms (2).

SANITARY AND HYDRAULIC ENGINEERING

ASSISTANT PROFESSOR PAYROW

The designing of reservoirs, tanks, and pipe lines for water supply systems, and of sewers and other appurtenances for sewerage systems. Inspection of existing plants, with reports thereon. Two terms (4).

NAVAL ENGINEERING

ADVANCED SHIP DESIGN

PROFESSOR CHAPMAN

Advanced work in the design of cargo and passenger ships. The relation of size and speed of ships for the most economical performance in service; a study from actual layouts of the relative merits of various types of propelling machinery; subdivision and flooding calculations according to the rules of the Bulkhead Committee of the Board of Trade.

The design of special types of ships and sailing yachts. Two terms (5).

THE POWERING AND PROPULSION OF SHIPS

PROFESSOR CHAPMAN

An advanced course consisting of a study of powering and propeller data and a comparison of the work of various investigators. Two terms (2).

THE STRENGTH OF SHIPS

PROFESSORS FOGG AND CHAPMAN

Investigation of the stresses set up in a ship's structure with particular application to special types of construction. Two terms (3).

LATIN

PROFESSOR WRIGHT

An advanced course in the Latin language and literature or in one of the branches of Roman antiquities, arranged with each candidate individually on application. Two terms (5).

METALLURGY

THERMO-CHEMISTRY AND THERMODYNAMICS OF THE METALS

ASSOCIATE PROFESSOR ROUSH

A study of the melting points, vapor tensions, specific heats, and latent heats of fusion and of vaporization of the metals, from practical and theoretical viewpoints; also, of the heats of formation of compounds of the metals, and the relation of these to atomic weights and other chemical and physical properties. Lectures and laboratory work. First term (5).

THERMO-CHEMISTRY AND PHYSICS OF METALLIC ALLOYS

ASSOCIATE PROFESSOR ROUSH

A study of the physical and chemical properties of metallic alloys, their melting points, specific heats, latent heats of fusion, heats of formation and microscopic structures. Lectures and experimental work. Second term (5).

ELECTROMETALLURGY

ASSOCIATE PROFESSOR ROUSH

A study of the conditions of deposition of metals and alloys in electrolysis, electrolytic separations, formation of metallic compounds by electrolysis, energy absorption in electrolysis. Lectures and laboratory work. First term (5).

TUITION AND OTHER FEES

The tuition fees are as follows: In the College of Engineering, $300 for the year or $180 for either term; in the College of Business Administration, $250 for the year or $150 for either term; in the College of Arts and Science, $200 for the year or $120 for either term.

The tuition for Chemistry offered in the Summer term immediately following Commencement Day is $25; for all other subjects, $30. No charge is made for such subjects to students who have paid tuition for the previous year, provided the subjects in question are a scheduled part of the technical courses they are pursuing. A graduation fee of $10 is paid by all candidates for a degree. A registration fee of $10 is paid by each student yearly.

All fees are payable at the office of the Bursar in Drown Memorial Hall. Tuition fees are payable in two instalments, on the opening day of the college year in September, and on the first day of the second term in February. The first instalment is $180, or $150, or $120, according to the course, and the second instalment is $120, or $100, or $80, according to the course. Application may be made for a return of part of the tuition fee if a student has formally withdrawn from the University after less than fours weeks' attendance in either term, but the amount thus refunded will in no case exceed one-half of the last instalment paid.

Students who fail to pay tuition fees when due will be notified that their attendance at college exercises must be discontinued until payment is made.

EXPENSES

Books, stationery, and drawing instruments may be bought by students at low prices at the Supply Bureau in Drown Memorial Hall. For work in the laboratories, materials may be obtained from the University, students paying a fee or making a deposit at the opening of the term covering the value of the materials. The amounts of these deposits are given under the detailed statements of laboratory courses in the List of Studies.

The University dormitories accommodate 171 students. The charge for single rooms is $80 a year; suites of three or four rooms rent at $100 for each occupant.

Students may obtain table board at the College Commons. The rate is $25 for thirty consecutive days. Numerous private householders in the city offer rooms and board at moderate charge.

Necessary expenses for the collegiate year, clothing and traveling not included, are estimated at $600 in addition to tuition. This includes attendance at the required summer schools.

SITE

Bethlehem is situated at the junction of the Lehigh Valley, the New Jersey Central and the Philadelphia and Reading Railroads. The University buildings are about a half-mile from the station. New York is eighty-six and Philadelphia fifty-seven miles distant.

BUILDINGS AND GROUNDS

The University occupies nineteen buildings, and its grounds cover 180 acres on the north side of South Mountain, overlooking the valley of the Lehigh River and the city of Bethlehem.

PACKER HALL

Packer Hall, completed in 1869, is four stories in height, 215 feet long, and 60 feet wide. It is built of Potsdam sandstone in the English Gothic style of architecture.

The Department of Civil Engineering occupies the greater part of the first and second floors of Packer Hall. On the first floor are a lecture room, two recitation rooms, a large drawing hall, two instrument rooms, two offices and a library room. The instrument rooms contain seventeen transits, fourteen levels, a large geodetic theodolite, two plane tables and other instruments for engineering field work. In the library room is a collection of plans of engineering structures. On the second floor are two drawing-rooms, three recitation rooms, an instrument room, a blue-print room, and offices.

On the third and fourth floors are to be found the offices and recitation rooms of the Department of Mathematics and Astronomy.

In the basement are located the store rooms and gallery range of the Department of Military Science and Tactics.

The offices of the President, Vice-President, Secretary of the Faculty and Registrar are on the second floor of Packer Hall.

THE WILLIAM H. CHANDLER CHEMICAL LABORATORY

The Chemical and Metallurgical Laboratories are contained in a fire-proof sandstone building, 259 feet in length by 44 in width, with two wings, each 62 feet in length by 42 feet in width.

In the Chemical department there are two principal stories, a basement and a topmost story given over to the laboratory for physical chemistry. The upper floor is occupied by the quantitative and the qualitative chemical laboratories. These rooms are 22 feet in height, and are well lighted and ventilated. Laboratories for research chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a smaller lecture room, a recitation room, a chemical museum, and laboratories for organic chemistry and sanitary chemistry.

In the basement is a large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis; also rooms containing the apparatus for processes in industrial chemistry, steam engine and dynamo and motor installation, air pump for pressure and vacuum filtration, etc.

The University has recently completed an extenison of the Chemical Laboratory. It is three stories high, in architectural conformity with the main building, and has inside dimensions of 60 feet by 37 feet. The equipment of these laboratories is of the most modern type, and every accessory to comfort and efficiency in expediting laboratory work is provided.

The Metallurgical department contains a lecture room; a museum of metallurgical collections; an extensive departmental library; a dark room for photographic work; a laboratory provided with a spectroscope, two Le Chatelier and one Leitz metallographic microscopes complete with camera; a dry laboratory provided with gas and electric furnaces, and electric current for electrometallurgical experiments. Equipment is provided for laboratory work in metallurgy, metallography, and particularly in electrometallurgy, consisting of

gas, electric current and apparatus for various kinds of experimental work. Several new pyrometers, calorimeters, and furnaces have been added recently to the general equipment. This department is therefore equipped for the instruction of classes in metallurgy and electrometallurgy of the regular curriculum, to afford facilities to students for familiarizing themselves with the methods of measurement and research employed in metallurgy and electrometallurgy, and for conducting original investigation in these departments of science.

The Trustees of the University named this building The William H. Chandler Chemical Laboratory in recognition of Dr. Chandler's thirty-five years' service as Professor of Chemistry, 1871-1906.

THE PHYSICAL AND ELECTRICAL ENGINEERING LABORATORY

The Physical and Electrical Engineering Laboratory is 240 feet long, 44 to 56 feet wide, and four stories high. The halls and stairways, the photometer rooms, and all apparatus rooms are of fire-proof construction. The remainder of the building is of heavy mill construction.

On the first floor are the Advanced Electrical Laboratory and shops of the Physics Department, the Senior and Junior dynamo laboratories, the shop and research room of the Electrical Engineering Department, and a storage battery room belonging jointly to the Departments of Physics and Electrical Engineering.

The dynamo laboratory for Senior students in the west wing is supplied with power from a 75-kilowatt rotary converter receiving current from the University power plant through two 30 kilowatt transformers. The dynamo laboratory equipment, which is being constantly increased, now includes the following apparatus: an 18-kilowatt double current generator, two direct current motor-generator units, one Lincoln variable speed motor, a 4-kilowatt Westinghouse two-phase rotary converter, a 10-kilowatt General Electric six-phase compound rotary converter, two direct connected units consisting of 7½-kilowatt six-phase General Electric alternators driven by 15-horse power Allis-Chalmers motors, one 20-kilowatt two- (or three-) phase alternator built by the Department, a 35-kilowatt

Westinghouse single-phase alternator, a 10-kilowatt composite wound alternator driven by a 15-horse power Crocker-Wheeler motor, a pair of 3-horse power direct connected series crane motors, three motor-generator sets converting from alternating to direct current, four polyphase induction motors ranging from 2-horse power to 7½-horse power, three types of single-phase induction motors, two single-phase commutator motors, twenty-two transformers of from 1 to 15-kilowatts, including two 15-kilowatt Scott-connected transformers, a 5-kilowatt 66,000-volt testing transformer, a 6-light constant current transformer, a 30-ampere arc rectifier outfit complete, a General Electric oscillograph outfit, a Crane lecture room oscillograph, and a variety of instruments, including voltmeters, ammeters, watt-meters, rheostats, contact makers, frequency meters, dynamometers, condensers, and other apparatus.

The dynamo laboratory for Junior students on the first floor in the west wing contains the following apparatus: a 20-kilowatt Ferranti alternator driven by a direct current motor, two arc light machines, twenty arc lamps of various types, a Brackett cradle dynamometer, a Westinghouse two-phase rotary converter, a motor driven battery-booster set, several types of adjustable speed motors, and other motors for direct and alternating currents.

On the second floor are the offices of the Departments of Physics and of Electrical Engineering, two general apparatus rooms, a large laboratory room for Physics, the Library of the Department of Physics and a small research laboratory, a large dynamo laboratory for Sophomore students in Electrical Engineering, and an Electrical Engineering reading room. The dynamo laboratory for Sophomore students in the west wing is equipped with twenty-seven direct current machines of various types, dynamotors and several types of automatic starters and auxiliary apparatus. Apparatus exemplifying the operation of telegraph, telephone, and radio telegraph and telephone stations are here installed. The equipment in radio telegraphy and telephony includes a 250-foot antenna, 5-kilowatt transformer, oscillation transformer, a 3000-volt direct current generator, quenched gap, and several sets of receiving apparatus.

On the third floor are the lecture room, apparatus rooms and photometer rooms of the Department of Physics, and lecture room, recitation rooms, apparatus room, and radio laboratory of the Department of Electrical Engineering.

On the fourth floor are recitation rooms and two large laboratory rooms of the Department of Pyhsics.

THE W. A. WILBUR ENGINEERING LABORATORY AND POWER HOUSE

The W. A. Wilbur Engineering Laboratory was erected in 1902; in 1907 the original building was doubled in size, the addition containing the new heating and lighting plant of the University. The building is of sandstone, conforming in material to the adjacent Chemical and Physical Laboratories. It is 44 feet wide by 188 feet long, one story high in the boiler room, but with a raised engine room forming a second story at either end.

The boiler equipment of the laboratory consists of two water-tube boilers rated at about 100-horse power each, one of Babcock & Wilcox, the other of Sterling type. In the heat and light plant there are three 250-horse power Sterling boilers, with room for a fourth unit of equal or greater capacity. Each section has its own set of feed pumps and other auxiliaries, in the arrangement of which special provision has been made for easily conducting performance tests. The laboratory boilers are connected to the chimney of the old boiler house, and have also an induced draft outfit. The chimney of the newer plant is of radial brick construction, 125 feet high, and a forced draft equipment is to be installed when need for increased capacity arises.

A coal-storage yard north of the building has room for a season's supply of coal, and a system of belt-conveyors and bucket-elevators is provided for receiving coal, dumping it on storage pile, and conveying it into the boiler room as needed.

The engine room of the laboratory, 50 feet long, contains a vertical triple-expansion engine of 75-horse power, a 60-horse power compound two stage Ingersoll air compressor, a small tandem-compound yacht engine, a simple Ball engine direct connected to a 25-kilowatt Crocker-Wheeler generator, and a 5-horse power De Laval steam turbine. There is also a complete set of Westinghouse airbrake apparatus, with four freight

car brakes. The airbrake pump and all the other small motors, including the feed and condenser pumps, are piped to the surface condensers beneath the engine room floor. There are two large condensers of 150- and 60-horse power capacity respectively, with smaller ones for the pumps and for special experiments. Besides the various engines there is a large belt dynamometer, apparatus for testing gages, indicators, thermometers, steam calorimeters and other instruments, and for experiments on flow of steam, for testing injectors, etc. The exhaust system includes a Cochrane feed-water heater of 250-horse power capacity.

The engine room of the power house is 31 feet long, with concrete floor. The generating units now installed are of 50 and 100-kilowatt rating, and there is room for a third of larger size. Simple horizontal Ball engines are direct connected to General Electric alternating current generators, which furnish 60-cycle two-phase current at 2200 volts for transmission to the various distributing centers. An engine-driven and a motor-driven exciter, with the switchboard, complete the electrical equipment. The engines exhaust through a Cochrane heater, and the exhaust steam may be discharged directly into the low-pressure system during the heating season.

A floor space 45 feet by 70 feet in the old boiler house is now used as a laboratory. It contains a 150-horse power suction gas producer for anthracite coal and apparatus for gas-power engineering and hydraulics, and for minor thermodynamic experiments with steam.

This building bears the name of Mr. W. A. Wilbur in grateful recognition of the work he has done for Lehigh University.

WILLIAMS HALL

Williams Hall was the donation of Dr. Edward H. Williams, jr., of the Class of '75, and was so named by the Trustees of the University not only in recognition of this gift but also of Dr. Williams' long continued and important service to the University as an alumnus and as Professor of Mining and Geology.

Williams Hall is 186 feet long by 70 feet wide and covers a ground area of over 12,000 square feet. One-half of the building is devoted to the Department of Mechanical Engi-

neering and the other half to the Departments of Geology and Biology.

In the eastern end there are recitation rooms, instructors' offices, drawing-rooms, reference library, and store-rooms of the Department of Mechanical Engineering, and in the basement rooms and apparatus are provided for laboratory work in experimental mechanics and engineering physics, such as the calibration of the measuring instruments used in Mechanical Engineering, the determination of the mechancal efficiencies of hoisting and other gear, and the testing of motors. In this section there are electric motors, a water motor, a 15-horse power centrifugal pump, hoists, blocks, jacks, and dynamometers of various kinds.

In the west end the Department of Geology has on the first floor two lecture rooms, two offices, library, mineralogical museum, and laboratory of petrology and petrography. The lecture rooms contain specimens of rocks and fossils and a collection of economic minerals and ores. The main lecture room is fitted with a stereopticon for illustrated lectures. The laboratory of petrography is provided with fifteen high-grade petrographic microscopes, and study collections of rocks and minerals. The collection of rocks contains over six thousand specimens from type regions in different parts of the world. The mineralogical museum contains many valuable collections representing all the prominent mineral localities in the world. In the basement are the mineralogical laboratory, the blowpipe analysis laboratory, a small chemical laboratory for analytical work, and a room fitted with apparatus run by a one-horse power motor for cutting thin sections of rock. On the second floor is the paleontological museum, which contains the fossil collections. On the third floor is a room fitted as an office and laboratory, containing a Goldschmidt's two-cycle goniometer and other apparatus for advanced work in crystallography.

On the third floor there are the drawing room and an office of the Mining Department, also well-equipped blue-print and dark rooms and a photographic laboratory used jointly by the Departments of Mining and Geology.

The Department of Biology has its lecture room, office, reference library, laboratories, and store rooms on the second floor, and a large vivarium on the third floor. The labora-

tories of this Department are thoroughly equipped with collections, sections, microscopes and necessary appliances.

Two students' rooms, used by the Mining and Geological Society and by the Mechanical Engineering Society, are located in the basement.

THE FRITZ ENGINEERING LABORATORY

The late John Fritz, of Bethlehem, known as the father of the steel industry in the United States, and a member of the Board of Trustees dating from the founding of the University, gave to the University the funds for the erection and thorough equipment of an engineering laboratory. The building was designed and erected in 1910 under the personal supervision of Mr. Fritz. The building is equipped with a general testing section for testing iron and steel, a cement and concrete section, and a hydraulic section. The equipment is used by the Civil Engineering Department in connection with courses in Strength of Materials, Hydraulics, and Cement. Any student in the University who has the proper preparation may receive instruction in this laboratory.

The building is of modern steel frame construction, 94 feet wide and 115 feet long, with the main central section 65 feet in height, and two side sections of lessor height. The external walls which enclose the steel frame are of cement brick lined on the inside with red brick. A traveling crane, of 10-ton capacity, operated by electricity, commands the entire central portion of the building in which the testing of large specimens is carried on.

The general testing section is equipped with an 800,000-pound Riehlé vertical screw testing machine, capable of testing columns 25 feet long or less, tensile specimens 20 feet long or less, and transverse specimens up to lengths of 30 feet; an Olsen universal testing machine of 300,000 pounds capacity; smaller machines for ordinary tension, compression, transverse and torsion tests; a cold-bend testing machine, and a small machine shop. The hydraulic section occupies the east end of the main room and is equipped with various tanks, weirs, pumps and other apparatus for studying problems in hydraulics. The cement and concrete section has a large room for the making and testing of specimens and a room for the storage of materials.

THE ECKLEY B. COXE MINING LABORATORY

The Eckley B. Coxe Mining Laboratory is a building of dressed sandstone, 100 feet long by 75 feet deep, one story high in front with a raised floor in the rear.

The main part of the building contains the Ore Dressing Laboratory, 40 feet by 70 feet; the west wing contains a chemical laboratory, an assay room, a balance room, and a sampling laboratory; the east wing contains the office, recitation room and an instrument room. There is a locker and wash room in the basement of the east wing.

The equipment for the main laboratory, most of which was made by the Allis-Chalmers Co., consists of a gyratory crusher, rolls, screens, jigs, Huntington mill, classifiers, concentrators (tables and vanner), gravity stamps, amalgamating plates, grinding pan, with the necessary apparatus, including grizzly, elevators, feeders, sand-pumps, settling tanks, dryers, and electric motors. The sampling laboratory contains a small jaw crusher, a small gyratory crusher, rolls, sample grinder, and a magnetic separator.

The machinery is driven by seven separate motors, and any one part or all of it can be operated at will, permitting experimental studies and tests of individual machines or groups of machines, or of an entire process, as occasion may require. The entire plant is thus flexible and enables combinations of processes in order to determine the best method to pursue in the treatment of ores, by coarse and fine concentration, and also in the preparation of coals.

Owing to the prominence which flotation methods have assumed in ore concentration, a special department of the main laboratory has been equipped for this work, and several types of testing machines have been installed, together with the necessary equipment of motors, air compressors, etc., for their operation.

The laboratory houses also the following equipment: large and small size Ingersoll-Rand rock drills, Stoper and Jackhammer drills, an Ingersoll-Rand pick machine for coal mining, a Water-Leyner rock drill, a Sullivan hand-power diamond drill machine, and a Temple-Ingersoll electric-air drill.

The laboratory has been named by the Trustees of the University "The Eckley B. Coxe Mining Laboratory" in mem-

ory of Eckley B. Coxe, who was universally recognized as a pioneer and a leader in the profession of mining engineering in this country, an active friend and valued Trustee of the University from its early days until his death. The Engineering and Mining Laboratories of Lehigh University, bearing the names of John Fritz and Eckley B. Coxe, record the friendship and close association of these two great engineers in their life-time, and their active interest in Lehigh.

CHRISTMAS HALL

Christmas Hall has historic interest as the first building of Lehigh University. It was originally a church, which was purchased from the Moravian Congregation. In the earliest years of the University it contained a chapel, lecture rooms and students' dormitory. After Packer Hall was completed in 1868, Christmas Hall and Saucon Hall were utilized as students' dormitories and mess hall up to 1885. For many years thereafter Christmas Hall was used by the Departments of Latin, Greek and Modern Languages.

The building is now largely devoted to the Department of Military Science and Tactics.

The office and recitation room of the Department of Greek are on the second floor.

SAUCON HALL

Extensive alterations to Saucon Hall were made in 1896, adapting it to the needs of the Department of English. It contains a study and a recitation room for each instructor, a lecture hall seating 200 persons, and a large room on the ground floor which has been fitted up for the use of the literary societies, with committee rooms adjoining.

COPPÉE HALL

Coppée Hall, formerly the Gymnasium, was completely renovated in 1913 to adapt it to the needs of the College of Arts and Science. On the first floor is a large lecture room, the office and recitation rooms of the Department of Economics and accounting rooms for instruction in Business Administration. On the second floor are the offices and recitation rooms of the Departments of Latin, German, Romance Languages, Philosophy and Education. The Psychological Laboratory, also situated on the second floor, is equipped for

elementary instruction and experimentation in the psychology of sense and movement. On the third floor are the seminar room of the College of Arts and Science, also a large room for the use of Accounting and a Statistical Laboratory.

SAYRE OBSERVATORY

By the liberality of the late Robert H. Sayre, one of the Trustees of the University, an Astronomical Observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

The Observatory contains an equatorial telescope by Alvin Clark, of six inches clear aperture and of eight feet focus; a zenith telescope, by Blunt; a superior astronomical clock, by William Bond & Son; a meridian circle; a prismatic sextant, by Pistor and Martins; an engineer's transit and a sextant, by Buff and Buff. Students in practical astronomy receive instruction in the use of the instruments and in observation.

The land upon which the Observatory stands, consisting of seven acres adjoining the original grant, was presented to the University by the late Charles Brodhead, of Bethlehem.

Sayre Observatory Annex

Sayre Observatory Annex contains a modern zenith telescope of four and one-half inches clear aperture, equipped with electric illumination. The building and instruments were presented to the University by the late Robert H. Sayre in 1903. Observations secured with this instrument are for the purpose of investigating the Variations of Latitude.

THE PACKER MEMORIAL CHURCH

The Packer Memorial Church, in which daily chapel exercises are held, was the munificent gift of the late Mrs. Mary Packer Cummings, daughter of the founder of the University. It was built in 1887 and is one of the largest churches in the State. During 1909-10 it was thoroughly renovated; the walls were newly frescoed, new stained glass windows put in place, and electric lights installed. These improvements were made possible by the continued generosity of the donor, Mrs. Cummings.

THE UNIVERSITY LIBRARY

The Library building was erected by the founder of the University in 1877, at a cost of $100,000, as a memorial to his daughter, Mrs. Lucy Packer Linderman.

The building is semi-circular with a façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior there is a reading room 40 by 50 feet from which radiate book cases extending from floor to ceiling; two galleries afford access to the upper cases. Shelf room is provided for one hundred and sixty thousand volumes. One hundred and fifty thousand volumes are now upon the shelves. The list of periodicals numbers about four hundred. The Library is open from 8 A.M. to 9 P.M., except on Sundays and holidays.

The free use of the Library, with the privilege of taking out books, is offered to students of every department on presentation of their registration cards. The use of the books and of the periodicals within the building is free to all persons. Resident graduates of the University have the full use of the Library on payment of three dollars annually. Persons pursuing systematic investigation in any study may be allowed the free use of the Library for a period not exceeding three months without fee. At the discretion of the Director, a deposit may be required when books are issued.

The Eckley B. Coxe Memorial Library

In memory of Eckley B. Coxe, who was for many years a Trustee of the University and who was profoundly interested in its welfare, Mrs. Coxe presented to the University his technical library, consisting of 7727 volumes, together with 3429 pamphlets. As the working library of a man who was remarkable as well for the breadth of his culture as for the extent and thoroughness of his acquaintance with the whole field of applied science, this addition to the resources of the University possesses the greatest value for all professional students.

TAYLOR HALL

Taylor Hall, the gift of Mr. Andrew Carnegie, is a commodious concrete dormitory situated in the University Park, south of Packer Hall. It accommodates 137 students. There

are suites of three rooms, (a study and two adjacent bed rooms,) for two occupants, and a few single rooms. The building was named Taylor Hall by Mr. Carnegie in honor of Mr. Charles L. Taylor, his former partner in business, a graduate of the University in the Class of 1876 and a Trustee of the University. The rates for the suites of rooms are $100 a year for each occupant. The single rooms are $80 a year.

PRICE HALL

Price Hall furnishes dormitory accommodation for thirty-four students. It is named in honor of Dr. Henry R. Price, an alumnus of the University of the Class of 1870, President of the Board of Trustees.

Application for rooms in the dormitories should be filed with the Bursar.

DROWN MEMORIAL HALL

Drown Memorial Hall is a memorial to the late Thomas Messinger Drown, LL.D., president of the University from 1895 to 1904. The building was erected by his friends and the alumni of the University and is devoted to the social interests of the University students. It contains study, reading, conversation, and chess rooms, an assembly hall, and the offices of the Alumni Association, the Young Men's Christian Association, the college publications, the dramatic and musical organizations. It also accommodates the Supply Bureau, conducted by the University, the purpose of which is to furnish books, stationery and supplies to the students at reasonable prices. The profits of the Supply Bureau are applied to the upkeep of Drown Memorial Hall.

The office of the Bursar is in Drown Memorial Hall.

THE COLLEGE COMMONS

The Commons was erected in 1907 to furnish a place where students might obtain wholesome food at cost. There are accommodations for 400 students. The present rates for table board are $25 for thirty consecutive days.

TAYLOR GYMNASIUM AND FIELD HOUSE

In 1913 Mr. Charles L. Taylor, a graduate of the University of the Class of 1876 and a member of the Board of Trustees, donated to the University the funds required for the erection of a gymnasium and a field house.

Taylor Gymnasium is situated at the extreme east end of the grounds of the University, adjoining the athletic field. The building is 222 feet long by 73 feet wide. On the ground floor at the north end is located the game room, 93 by 70 feet, used for basketball and wrestling. The game-room is surrounded by a gallery for spectators. The main gymnasium floor measures 90 by 70 feet. Other rooms in Taylor Gymnasium are the offices and measuring room of the Department of Physical Education, a large trophy room, basketball and handball courts, fencing, boxing and wrestling rooms, and locker rooms with accommodations for the entire student-body.

The gymnasium is equipped with all modern appliances for recreative and corrective exercises, also with apparatus for calisthenic and other gymnastics, both for individual and for class work.

In addition to numerous hot and cold shower baths, adjoining the locker rooms is a swimming pool, 75 by 25 feet, with a depth from 4½ to 9½ feet. The capacity of the swimming pool is 95,000 gallons.

Adjoining the gymnasium and the stadium is the Taylor field house. It is two stories in height, and has dressing rooms, lockers and shower baths for visiting and Lehigh teams, and also rooms for medical attention to athletes.

TAYLOR FIELD

An athletic field of more than nine acres in area is provided by the University for the accommodation of students who participate in the various outdoor sports. The Stadium is located on the north side, or lower level, and provides football and baseball fields. It is surrounded by concrete stands having a seating capacity for more than 12,000 spectators. On the upper level there are practice fields for football, baseball, lacrosse and soccer, also a quarter mile track and a 220-yards straightaway, furnishing ample room for exercise by the entire student-body. During the winter months a wooden outdoor running track, fourteen laps to the mile, is provided.

A cage with 60 by 120 feet floor space affords facilities for rifle practice, indoor baseball, lacrosse, and track and field sports practice.

All athletic sports are under the direction and oversight of the Professor of Physical Education, who is aided by an

Athletic Committee composed of alumni and students, members of the Faculty, a member of the Board of Trustees, and the President of the University.

SAYRE PARK

A development of the mountain side of the University grounds was effected through the donation to the University in 1909 of the sum of $100,000 by the children of the late Robert H. Sayre to be applied and used in the development of Sayre Park as a memorial to their father. Mr. Sayre was a Trustee of the University from its foundation in 1866 to his death in 1907. He acted for years as President of the Board of Trustees, and as Chairman of the Executive Committee of the Board, and his services to Lehigh were constant and great.

THE ARBORETUM

The Arboretum is a tract of about eleven acres added in 1909 to the upper end of Sayre Park. It was established by a lover of Forestry and a friend of the University as a tree nursery for the purpose of furnishing illustrative specimens of American trees, and of cultivating trees and shrubs for the beautifying of the Park. All of the more important species of North American trees are to be found in the University Park and the Arboretum. Adjoining the Arboretum a tract of seven acres has been planted with a variety of indigenous trees as an exhibition growth of tree culture.

THE UNIVERSITY MUSEUMS

The University Museums include large collections illustrating various branches of Chemistry, Metallurgy, Geology, Mineralogy, Zoölogy, and Archæology.

The Metallurgical Cabinet contains specimens illustrating the various processes for obtaining the more common metals.

The Zoölogical collections include the Packer collection of recent shells and the Werner collection of American birds. The latter contains over three hundred and fifty species. In most cases, in addition to the adults, specimens in different plumages as well as the nests and eggs are represented.

The Geological and Mineralogical Museums are housed in the west end of Williams Hall, and contain the Roepper and Keim mineral collections, collections of fossils, specimens of ore from mining districts, and extensive series of rocks which

illustrate the type occurrences in different parts of the world.

The Cummings Archæological Cabinet has three thousand specimens and includes Dr. Stubb's collection of Indian relics, weapons and utensils.

UNIVERSITY LECTURES

From time to time during the University year, distinguished men in science, letters, art and business give lectures before the student-body.

HONORARY SCHOLARSHIP SOCIETIES

PHI BETA KAPPA. Students in the College of Arts and Science and the College of Business Administration who up to the middle of the Senior year maintain high scholarship may be elected to membership, also a limited number of technical students whose work in philosophical, scientific, and language studies is of high grade.

TAU BETA PI. Students in the College of Engineering who up to the middle of the Junior year maintain high scholarship may be elected to membership.

SOCIETIES OF THE COLLEGE OF ENGINEERING

An adjunct of value in promoting professional spirit in the College of Engineering is furnished by the departmental societies,—volunteer organizations of students who meet monthly to present papers, to discuss engineering topics and, from time to time, to hear addresses by invited engineers and scientists of note.

The first of these organizations historically was the Chemical Society, organized in 1871. The original Engineering Society, open to all technical students of the University, was started in 1872. From 1885 to 1889 it issued quarterly numbers of *The Journal of the Engineering Society of Lehigh University*, containing contributions by members, alumni and others. Many of the papers read before this Society from 1890 to 1893 were published in the *Lehigh Quarterly* of those years.

Independent societies were formed in 1900 by students in the Departments of Civil Engineering and Mechanical Engineering. The Electrical Engineering Society, founded in 1887, was reorganized in 1901. The Mining and Geological Society began in 1904, the Metallurgical Society in 1917, and the Railroad and the Naval Engineering Society in 1920.

THE ARTS AND SCIENCE CLUB

The Arts and Science Club is the student society of the College of Arts and Science. It was founded in 1905, with the aim of promoting literary and cultural interests in the University. Students in all courses are eligible for membership. The programs of meetings include papers by members, discussions led by teachers in the College, and occasional talks by scholars from other institutions.

THE Y. M. C. A. OF THE UNIVERSITY

The Christian Association is a voluntary organization of the students for the promotion of the religious, moral, and social life of the University. It was organized April 18, 1890, and on October 11, 1890, united itself with the intercollegiate Young Men's Christian Association. The movement is distinctly for and by students, all the officers, with the exception of the General Secretary, being chosen from the student-body. The General Secretary is Mr. Sterling G. Harris, whose office is in Drown Memorial Hall.

PUBLIC WORSHIP

Morning prayers are held in Packer Memorial Church at 7:45 a.m. on every week day except Saturday. Attendance of students is required.

FOUNDER'S DAY

On the first or second Saturday of October of each year, commemorative exercises are held in honor of the founder of the University. On Saturday, October 14, 1922, the forty-third Founder's Day was celebrated. In connection with these exercises Charles Russ Richards, Eng.D., LL.D., was installed as President of the University.

UNIVERSITY SUNDAY

The University sermon is preached on the Sunday before University Day. The Rt. Rev. Philip Cook, D.D., Bishop of Delaware, was the preacher on Sunday, June 11, 1922, in the Packer Memorial Church.

HONOR SYSTEM

The Honor system is in force at Lehigh University, having been adopted by the unanimous action of the student-body.

GRADUATING THESES

Theses, when reqired, are accompanied by drawings and diagrams, whenever the subjects need such illustration. The originals are kept by the University, as a part of the students' record, for future reference, but copies may be retained by students, and may be published, permission being first obtained from the Faculty.

UNIVERSITY DAY

University Day is the close of the collegiate year. On this day graduation exercises are held at which an address is given by a representative of the Alumni Association, prizes and honors are awarded, and degrees are conferred.

The program of the exercises on June 13, 1922, was as follows:

MUSIC

PRAYER

ALUMNI ADDRESS

FLOYD WILLIAM PARSONS, E.M., '02

ANNOUNCEMENT OF PRIZES AND HONORS

The Wilbur Scholarship of $200,

CHARLES FRANCIS HILLER, of Buchanan, Mich.

First in rank in the Sophomore Class.

The Alumni Prizes of $25, for the first honor men in the Junior Class in various departments,

Electrical Engineering,

CLEMENT SOLOMON SCHIFREEN, of Catasauqua, Pa.

Chemistry and Chemical Engineering,

CHARLES HECK MILLER, of Ancora, N. J.

The Wilbur Prizes of $10 for excellence in the studies of the Sophomore year,

In Mathematics,

ROBERT WILLIAM ENNIS, of Mount Penn, Pa.

In Physics,

JOHN C. KITCHIN, JR., of Columbia, N. J.

The Wilbur Prizes of $15 and $10, for excellence in the studies of the Freshman year,

In Mathematics,
First: RALPH ARTHUR LAMBERT, of Bethlehem, Pa.
Second: HARVEY H. SCHOCK, of Shartlesville, Pa.

In English,
ARTHUR STANLEY KING, of Toms River, N. J., and
CLARENCE HENRY PORTER, of Washington, D.C., jointly.

In German,
HARRY KNIGHT KERR, of Philadelphia, Pa.

In French,
PAUL JAMES FINEGAN, of Burlington, N. J.

The William H. Chandler Chemistry Prizes, of $25 each,
Freshman Year: JAMES BLISS AUSTIN, of Chicago Ill.
Sophomore Year: JOHN C. KITCHEN, JR., of Columbia, N.J.
Junior Year: CHARLES HECK MILLER, of Ancora, N. J.
Senior Year: CYRIL FINTON GOLDCAMP, of Ironton, O.

Prize of $25 for best Thesis in Department of Electrical Engineering,
HARRY HARRISON MARSH, JR., of Wheeling, W. Va.

SENIOR HONORS

College of Arts and Science,
First: MICHAEL FRESOLI, of Bethlehem, Pa.

College of Business Administration,
First: CHARLES JOSIAH DUNKLE, of Harrisburg, Pa.
Second: LESLIE LUNGREN DREW, of Asbury Park, N. J.

College of Engineering,

Civil Engineering Course,
First: EDWIN LEWIS REYNOLDS, of Bethesda, Md.

Mechanical Engineering Course,
First: ERNEST PAUL GANGEWERE, of Chattanooga, Tenn.
Second: ALEXANDER KORBEL, of Bethlehem, Pa.

Metallurgy and Mining Engineering Courses,
First: WILLIAM HENRY TAVENNER, of Washington, D. C.

Electrical Engineering Course,
First: JOHN WINEBRENNER HORINE, JR., of Columbia, S. C.
Second: ELMER FRANCIS DETURK, of Reading, Pa.

Chemistry and Chemical Engineering Courses.
First: CYRIL FINTON GOLDCAMP, of Ironton, O.
Second: GEORGE FREDERICK ADELBERT STUTZ, JR., of Washington, D. C.

JUNIOR HONORS

College of Arts and Science,

First: John Werner Kreisel, of Pen Argyl, Pa.

Second: John Kenneth Barrall, of Allentown, Pa.

College of Engineering,

Civil Engineering Course,

First, John Harold Van Ness, of Paterson, N. J.

Second: Charles Raymond Wire, of Washington, D. C.

Mechanical Engineering Course,

First: Edwin Alden Ferris, of Ridgewood Park, N. J.

Metallurgy and Mining Engineering Courses,

First: Robert Gair Pfahler, of Wilkes-Barre, Pa.

Second: Charles Owen Burgess, of Niagara Falls, N. Y.

Electrical Engineering Course,

First: Clement Solomon Schifreen, of Catasauqua, Pa.

Second: Edwin Henry Snyder, jr., of Washington, D. C.

Chemistry and Chemical Engineering Courses,

First: Charles Heck Miller, of Ancora, N. J.

SOPHOMORE HONORS

In Mathematics,

First: Robert William Ennis, of Mount Penn, Pa.

Second: John C. Kitchen, jr., of Columbia, N. J.

In Physics,

First: John C. Kitchen, jr., of Columbia, N. J.

Second: Robert William Ennis, of Mount Penn, Pa.

FRESHMAN HONORS

In Mathematics,

First: Ralph Arthur Lambert, of Bethlehem, Pa.

Second: Harvey H. Schock, of Shartlesville, Pa.

In English,

Arthur Stanley King, of Toms River, N. J., and Clarence Henry Porter, of Washington, D.C., jointly.

In German,

Harry Knight Kerr, of Philadelphia, Pa.

In French,

Paul James Finegan, of Burlington, N. J.

Degrees were then conferred as follows:

DEGREES IN COURSE

MASTER OF ARTS

Herbert Franklin Arnold, A.B., (*Franklin and Marshall College*)	Easton, Pa.
Carl Henry Karch, A.B. (*University of Pennsylvania*)	Allentown, Pa.
Henry Rath McCullough, A.B., (*Muhlenberg College*)	Allentown, Pa.
Warren Allen Ziegenfuss, A.B., (*Muhlenberg College*)	Allentown, Pa.

MASTER OF SCIENCE

August Concilio, E.E., (*Lehigh University*)	Bethlehem, Pa.
Mahlon L. Frankenfield, B.S., (*Muhlenberg College*)	Allentown, Pa.
George Joseph Roche, E.E., (*Lehigh University*)	Baltimore, Md.

BACHELOR OF ARTS

Ambrose Edward Dvorschak,	Drifton, Pa.
Michael Fresoli,	Bethlehem, Pa.
Charles Pennypacker Gooding,	Wilmington, Del.
Herman Ludwig Weber,	Allentown, Pa.
Harvey Alfred Zinszer	Bethlehem, Pa.

BACHELOR OF SCIENCE

Charles Josiah Dunkle,	Harrisburg, Pa.
Leslie Lungren Drew,	Asbury Park, N. J.
Carl Harry McKenzie,	Dallas, Tex.
Paul Knauss Whytock,	Bethlehem, Pa.

CIVIL ENGINEER

William Michael Donovan,	Philadelphia, Pa.
Edmond Joseph Downing,	Scranton, Pa.
James Royce Farrington,	Annandale, N. J.
James Robert Job,	Nanticoke, Pa.
Harold William Morgan,	Altoona, Pa.
Edwin Louis Reynolds,	Bethesda, Md.
George Robert Swinton,	Atlantic City, N. J.
Harold Dolson Wallace,	East Orange, N. J.
William Hurr Waltz,	Williamsport, Pa.
Edmund Joseph Whims,	Saint Clair, Pa.
Abram Reber Wingate, jr.,	Washington, D. C.

MECHANICAL ENGINEER

Roy Dawson Allen,	Belvidere, N. J.
William Henry Boland,	Westboro, Mass.
William Lloyd Bowler,	Glenside, Pa.
Henry Tregellas Bowman,	Schuylkill Haven, Pa.
Henry Carroll,	Bethlehem, Pa.
Lee Heicher Coleman,	Steelton, Pa.
Roy Lester Culler,	Mechanicsburg, Pa.
Ernest Paul Gangewere,	Chattanooga, Tenn.
Jacob Aaron Gerlach,	Easton, Pa.
Eduardo Gonzales,	Torreon, Coah., Mexico.
Charles Huntington Greenall,	Allentown, Pa.
Herbert Julius Kleine,	Philadelphia, Pa.
Alexander Korbel,	Bethlehem, Pa.
James Floyd Marshall,	Wilkes-Barre, Pa.
George Nass, 3rd,	Overbrook, Pa.
Paul Clader Reichard,	Allentown, Pa.
Samuel Procter Rodgers,	Baltimore, Md.
Auguste Louis Saltzman,	East Orange, N. J.
Carl Louis Schneider,	Elizabeth, N. J.
Earl Stimson, jr.,	Baltimore, Md.
Charles Carter Strauch,	Pottsville, Pa.
Peyton Leftwich Terry,	Roanoke, Va.
Lawrence Northrup Van Nort,	Scranton, Pa.

METALLURGICAL ENGINEER

Ray Long Eisenhard,	Allentown, Pa.
George Newlin Ewing,	Philadelphia, Pa.
Omar Vivien Greene,	Yonkers, N. Y.
Raymond Anthony Keenan,	New Kensington, Pa.
Arthur Rhea Little,	Petersburg, Pa.
Paul Fisher Mumma,	Waynesboro, Pa.
Clarence Prior Salmon,	Rochester, N. Y.
Leslie Clifton Whitney,	Marlboro, Mass.
Robert Thomas Wood,	Palmerton, Pa.

ENGINEER OF MINES

Herman Charles Beeckel,	Philadelphia, Pa.
Tsung-Fu Chen,	Changsha, China
James Coalter Crawford, jr.,	Mount Vernon, N. Y.
Daniel Benjamin Dimmig,	East Greenville, Pa.
Shou-Chuan Huang,	Kaiping, Chihli, China.
Albert McIlvaine Michell,	Marion, Ky.
Roy Francis Miller,	Altoona, Pa.
Adolph Theodore Prigohzy,	Brooklyn, N. Y.
William Henry Tavenner,	Washington, D. C.
Stuart Worley Williamson,	Womelsdorf, Pa.
John Edgar Miller Wilson,	Bethlehem, Pa.

ELECTRICAL ENGINEER

John Duffield Alrich,	Bethlehem, Pa.
Granville Martin Brumbaugh,	Washington, D. C.
Charles Taylor Deats,	Flemington, N. J.
Elmer Francis DeTurk,	Reading, Pa.
Robert C. Hicks, jr.,	Philadelphia, Pa.
John Winebrenner Horine, jr.,	Columbia, S. C.
Clinton H. Ide,	Harvey's Lake, Pa.
Claude Luther Knoderer,	Steelton, Pa.
Warren Hornberger Lutz,	Denver, Pa.
Harry Harrison Marsh, jr., A.B., (*Marietta College*)	Wheeling, W. Va.
John Walter Moorehouse,	Monaca, Pa.
Warren Cyrus Spatz,	Reading, Pa.
Watson Fergus Tait, jr., A.B., (*Marietta College*)	Parkersburg, W. Va.

CHEMICAL ENGINEER

John Lorah Bertolet,	Reading, Pa.
Paul Emil Bowman,	Schuylkill Haven, Pa.
Howard Stolpp Bunn, B.A., (*Lehigh University*)	Elkins Park, Pa.
Donald Moyer Bush,	Bethlehem, Pa.
James Stark Carey,	Harrisburg, Pa.
Frederick Mertz Christman,	Reading, Pa.
Richard James Clark,	Bethlehem, Pa.
Samuel Cottrell, jr.,	Washington, D. C.
William Eugene Gerber,	York, Pa.
Cyril Finton Goldcamp,	Ironton, O.
Abraham Albert Gross,	Harrisburg, Pa.
Walter Fitz James Hindry,	Saint Augustine, Fla.
Francis Christian Huber,	New York, N .Y.
Rupert DeArmond Hughes,	Montclair, N. J.
Frank Aaron Jacobs,	Bethlehem, Pa.
Noah Abraham Kahn,	Bethlehem, Pa.
Joseph Albert Kivert,	Northampton, Pa.
Robert Lee Lerch,	Tacoma Park, D. C.
Edward William McGovern, jr.,	Hammonton, N. J.
Chien-Chung Ma,	Amoy, China.
Harold Wagner Major,	Lehman, Pa.
Richard Henry Morris, 3rd,	Philadelphia, Pa.
Ralph Harrison Potts,	Reading, Pa.
Carlton Hecker Schlesman,	Allentown, Pa.
Walter Louis Shearer,	Washington, D. C.
Charles Forbes Silsby,	Washington, D. C.
Charles Frederick Adelbert Stutz, jr.,	Washington, D. C.
Theodore MacLean Switz,	East Orange, N. J.
Harold James Vogt,	Brooklyn, N. Y.
Charles Russell Wolfe,	Asbury Park, N. J.

NAVAL ENGINEER

Fred Elliott Bailey,	Cazenovia, N. Y.
Joseph Light Boltz,	Lebanon, Pa.
Everett Morgan Enslin,	Wilkes-Barre, Pa.
David Green,	Atlantic City, N. J.
Alfred Cope Hartshorne,	Phoenixville, Pa.
Moncrief Ostrander Jefferson,	Riverhead, N. Y.
Paul Edward Miller,	Bellwood, Pa.
Robert Rodney Rhoad,	Philadelphia, Pa.
Abraham Schropp Thaeler,	Nazareth, Pa.
Austin Bartlett Warren,	Westfield, Mass.
Harold Martin Woelfel,	Freeland, Pa.

HONORARY DEGREES

MASTER OF SCIENCE

Paul Bernard de Schweinitz, M.E., Bethlehem, Pa.

DOCTOR OF LAWS

Henry Sturgis Drinker, E.M., LL.D., Merion Station, Pa.

SCHOLARSHIPS, FELLOWSHIPS, AND PRIZES

THE WILBUR SCHOLARSHIP

The Wilbur Scholarship was founded in 1872 by the late E. P. Wilbur and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

THE HARRY S. HAINES MEMORIAL SCHOLARSHIP

Mrs. Henry S. Haines, of Savannah, Ga., established in 1889 a scholarship of the annual value of $200 as a memorial to her son, Henry Stevens Haines, M.E., a member of the Class of 1887. This scholarship is devoted to the support at Lehigh University, throughout his scholastic career, of one student in the Course of Mechanical Engineering.

THE FRED. MERCUR MEMORIAL FUND SCHOLARSHIPS

Friends of the late Frederick Mercur, of Wilkes-Barre, Pa., General Manager of the Lehigh Valley Coal Company, desiring to establish a memorial of their friendship and esteem, and to perpetuate his memory, contributed and placed in the hands of the Trustees a fund called "The Fred. Mercur Memorial Fund." The income from this Fund, amounting to $600, is annually awarded to students of the University.

THE JOSEPH MANN PRICKITT SCHOLARSHIP

Mr. and Mrs. Cooper H. Prickitt, of Burlington, N. J., established, in April, 1919, a scholarship, to be known as the

Joseph Mann Prickitt Scholarship, in memory of their son, Joseph Mann Prickitt, of the Class of 1917, who died on March 10, 1916.

This scholarship is of sufficient amount to cover expenses for tuition, fees and books. It is the expressed wish of the donors that the scholarship be awarded to graduates of the Burlington, N. J., High School on the nomination of the Principal of that school, subject to the approval of the President of the University, or in case of no nomination from that school that the award be made to deserving students from other places.

THE ECKLEY B. COXE MEMORIAL FUND

In memory of the late Eckley B. Coxe, Trustee of the University, Mrs. Coxe has established a fund, amounting to $64,350, the interest of which is used, under the direction of the Trustees of the University, and subject to such regulatons as they may adopt, for the assistance of worthy students requiring financial aid.

THE FRANK WILLIAMS FUND

Frank Williams, E.M., of Johnstown, Pa., a graduate of the course in Mining and Metallurgy of the Class of 1887, who died October, 1900, bequeathed to the University the greater part of his estate, now amounting to over $140,000, to found a fund, the income of which is lent to deserving students. At present the larger part of this income is devoted to certain life tenants under Mr. Williams' will. After their death the entire income will be available for loans.

THE CALLENDER-CARNELL FELLOWSHIP

The Callender-Carnell Fellowship for the promotion of research in chemistry, established in 1919, is a gift of $1500 annually by an anonymous friend of the late George D. Callender, a chemist, who died in Chicago in 1914 while associated with the donor of the scholarship, and of the late William C. Carnell. Mr. Callender was a native of Linlithgow, Scotland, and was graduated from the chemistry department of Glasgow University. Mr. Carnell was a graduate of the Course in Chemistry of Lehigh University, of the Class of 1894.

WILBUR PRIZES

A fund was established by the late E. P. Wilbur for distribution in prizes as the Faculty shall determine. This fund yields an annual income of $100.

THE PRICE PRIZE FOR ENGLISH COMPOSITION

Dr. Henry R. Price, an alumnus and Trustee of the University, established in 1898 an annual prize of the value of $25, to be awarded in June to that member of the Freshman Class who shall write the best essay on a topic in English Literature assigned by the head of the Department of English not later than the beginning of the second term in each year. Special stress will be laid upon clearness of thought and force of expression. Students must signify in writing their intention of competing not later than the first of April.

The subject for the prize essay in June, 1923, will be: "Irving's Works, the Spanish Group."

THE JOHN B. CARSON PRIZE

An annual prize of $50 was established in 1909 by Mrs. Helen C. Turner, of Philadelphia, Pa., in memory of her father, John B. Carson, whose son, James D. Carson, was a graduate of the Civil Engineering Department of Lehigh University in 1876. It is awarded for the best thesis in the Civil Engineering Department.

WILLIAM H. CHANDLER PRIZES IN CHEMISTRY

Four annual prizes in chemistry of $25 each were established in 1920 by the gift of Mrs. Mary E. Chandler, of Bethlehem, Pa., widow of Dr. William H. Chandler, who was Professor of Chemistry in Lehigh University from 1871 until his death in 1906. In memory of Dr. Chandler the Faculty named the prizes "The William H. Chandler Prizes in Chemistry." Awards are made at the commencement exercises in June to the four members of the Freshman, Sophomore, Junior and Senior classes deemed by the Faculty worthy to receive them.

THE ELECTRICAL ENGINEERING PRIZE

An annual prize of $25, established by an anonymous graduate of the Electrical Engineering course, is awarded to the member of the graduating class presenting the best thesis in Electrical Engineering.

THE ALUMNI ASSOCIATION

The Alumni Association, which has been in existeenc since 1876, was incorporated in 1917 under the name The Alumni Association of the Lehigh University, Inc. The Alumni Secretary, who devotes all of his time to Association affairs, is Walter R. Okeson, '96, whose offices are in Drown Memorial Hall. Mr. Okeson edits the *Lehigh Alumni Bulletin*, a news publication published monthly from October to June, inclusive, and the *Alumni and Student List.* An appointment bureau is maintained by the Association.

The officers of the Alumni Association for 1922-23 are:

President, Henry D. Wilson, '01, of Pittsburgh, Pa.

Vice-President, Clarence W. Hudson, '89, of New York, N. Y.

Vice-President, William A. Webb, '91, of Philadelphia, Pa.

Treasurer, Alan C. Dodson, '00, of Bethlehem, Pa.

Executive Secretary, Walter R. Okeson, '96, of Bethlehem, Pa.

Archivist, Preston A. Lambert, '83, of Bethlehem, Pa.

Honorary Alumni Trustees: Homer D. Williams, '87, of Pittsburgh, Pa.; William C. Dickerman, '96, of New York, N. Y.; Taylor Allderdice, '83, of Pittsburgh, Pa.; and Aubrey Weymouth, '94, of New York, N. Y.

The following are the local alumni clubs: New York Lehigh Club, Philadelphia Lehigh Club, Pittsburgh Lehigh Club, Chicago Lehigh Club, Washington Lehigh Club, Detroit Lehigh Club, Northeastern Pennsylvania Lehigh Club (Scranton and Wilkes-Barre, Pa.), Maryland Lehigh Club (Baltimore, Md.), Lehigh Club of New England (Boston, Mass.), Intermountain Lehigh Club (Salt Lake City, Utah), Lehigh Club of Central Pennsylvania (Harrisburg, Pa.), Lehigh Club of Northern New York (Schenectady, N. Y.), Lehigh Club of Northern Ohio (Cleveland, O.), Lehigh Club of Southern New England (Hartford, Conn.), Lehigh Club of Western New York (Buffalo, N. Y.), Southern Anthracite Lehigh Club (Pottsville, Pa.), Southwestern Lehigh Club (St. Louis, Mo.), Lehigh Home Club (Bethlehem, Pa.), Lehigh Club of China (Wuchang, China), Lehigh Club of Cuba (Havana ,Cuba).

ALUMNI PRIZES

By a resolution of the Alumni Association of September 21, 1900, the Alumni Scholarship Fund, which was originally designed to help poor students, was with the consent of the contributors diverted from this purpose and the income devoted to prizes to members of the Junior Class. In June, 1923, two prizes of $25 each will be awarded to the first honor men of the courses in Civil and Mechanical Engineering. In subsequent years the prizes will be awarded to the first honor men of the technical courses in turn.

ALUMNI PRIZES FOR ORATORY

The Alumni Association of Lehigh University established in 1882 annual prizes for excellence in oratory, amounting to $50.

Regulations

1. The contest shall be held on the 22nd day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second prize of $15, and a third prize of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the orations shall be announced at the beginning of the first term of every year, and upon one of these each competitor shall write an oration not to exceed 1200 words, taking about eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do—should they be sufficient in number—the best six shall be chosen and their envelopes opened. The others shall be returned to the addresses given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors whose orations shall have been approved, and the awards shall be made by a majority of these judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

The annual contest in Oratory for the Annual Prizes was held on February 22, 1922, with the following competitors:

Elmer Morton Bloch, of Newport, R. I.

David Getz, of Allentown, Pa.

Frederick William Trumbore, of Bethlehem, Pa.

Edwin Van Keuren, of Bethlehem, Pa.

The first prize was awarded to Mr. Getz, the second to Mr. Trumbore, the third to Mr. Van Keuren.

The judges were Prof. Preston A. Lambert, '83; Howard A. Foering, '90, and the Rev. David B. Clark, '01.

WILLIAMS PRIZES IN ENGLISH

Professor Edward H. Williams ,jr., an alumnus of the University of the Class of 1875, established in February, 1900, prizes amounting annually to $335 for excellence in English Composition and Oratory. The conditions of the endowment are as follows:

Sophomore Composition Prizes

1. At the beginning of each term the Sophomore Class shall be divided into two sections alphabetically and to that student in each section who, at the end of a term, and of each term, shall receive the highest rank in English Composition during that term shall be awarded the "First Sophomore Composition Prize" of ten dollars, and to that student in each section as aforesaid who shall receive the next highest rank in the same subject shall be awarded the "Second Sophomore Composition Prize" of five dollars. In each year there will be offered four first and four second prizes—a total of sixty dollars.

If more than one student shall receive the highest rank in any section, the amount of the two prizes shall be added together and the sum—fifteen dollars—shall be equally divided between them, and no second prize shall be offered in that section. If more than one student shall receive the next highest rank in any section when there is but one contestant for the first prize, the second prize shall be equally divided between the two having the second rank.

Senior Premiums

2. The Faculty shall publish within one month of the end of the University year a list of subjects for dissertaitons, selected from English Literature and Economics, entitled Subjects for Senior Premiums. To this list shall be appended a date near the first of January following—to be determined upon by the Faculty—when the contest shall be declared closed and the dissertations shall become due.

From the above list any member of the Senior Class may select a subject and write thereon a dissertation, whose length shall be prescribed by the Faculty, and shall send the same anonymously, but marked for identification, as the Faculty may direct, to the Secretary of the Faculty before the date aforesaid.

The Faculty, or its committee, shall meet on the above date and at subsequent adjourned meetings, and, first, having determined upon a standard of excellence which each and all dissertations must reach in

order to be admitted to the following competition, shall examine the dissertations submitted to them and admit those which reach the above standard. In case none are up to the standard, and are admitted they shall declare the contest closed for that year, and no prizes shall be awarded.

If one or more dissertations are admitted as aforesaid, the Faculty, or its committee, shall arrange them in the order of their literary merit and soundness of their reasoning, and the six highest in this arrangement shall be retained and all others returned as directed by the writers, who shall remain unknown. The names of the successful writers shall be ascertained and they shall be required to recast their dissertations in the form of an oration, and to speak the same in public at such time during the Commencement Week as the Faculty shall determine.

The Faculty, or its committee, shall be the judges of excellence in the speaking, and shall award to that Senior student who shall speak his oration in the best manner, the Senior Gold Medal, of the value of one hundred dollars, or, at his option, one hundred dollars in gold. They shall award to the other five speakers the five Senior Premiums of ten dollars each.

Graduate Prize

3. At the end of the University year, during Commencement Week, the Faculty shall publish a second list of subjects for theses selected from English Literature, Economics, Mental and Moral Science, and similar subjects which require thought and application, and which must be of such a character that their mastery shall be accomplished only through considerable research and study.

From this list any member of the class just graduating; the Senior Class of the coming University year; a graduate of one year's standing whether in or out of residence, and a graduate of any class who may be, during the coming year, in actual residence and taking post-graduate work at the University, may select a subject and write thereon a thesis of not less than five thousand words and send the same to the Secretary of the Faculty, anonymously, but marked for identification as the Faculty may designate, before the date, which the Faculty shall select within one month before the next Commencement, and which date must appear on the above list.

The Faculty, or its committee, shall meet on this date, and at adjourned meetings thereafter, and, having first established a standard of excellence, which must, first, be a hgih one, and second, shall require on the part of the competitor ability in the plan, development, argument, and conclusion of the work, as well as literary merit in its composition and presentation, shall admit to the following competition only those who fully attain to the above required standard.

If none of the theses submitted shall have attained to the standard aforesaid, the competition shall be declared closed and the prize shall not be awarded.

To the author of that thesis which shall have been admitted to the competition, and which shall have been declared of the highest excellence, the Graduate Prize of one hundred and twenty-five dollars shall

be awarded and presented on Commencment Day with the other prizes and awards of that day.

The successful thesis shall be the property of the University, but the author shall be allowed to retain one copy. Publication of the thesis by the author will only be permitted by vote of the Faculty. Such publication must, however, be entitled Graduate Prize Thesis of the Lehigh University.

The winner of a prize shall not be allowed to compete again.

Professor Williams has directed that the income derived from the endowment for the Williams Prizes shall be applied and used as follows.

1. All portions of said income remaining after the payment of all prizes awarded in any one year, shall be invested and added to the principal of said endowment.

2. If any prize shall, for any reason, be not awarded in any year, the sum thus unpaid shall be invested and added to the said principal.

3. If for any reason the amount of the income from said endowment shall fall below the total sum necessary to pay said prizes, the amounts of the individual prizes shall be proportionally reduced till their sum shall be equal to three-fourths of the said reduced income, and this three-fourths shall be used to pay them; the remaining one-fourth is to be invested and added to the said principal.

4. This investment of residues, as above said, shall continue till the principal of said endowment shall be sufficiently large to furnish an income at two per cent. interest, which will be sufficient to pay all said prizes now established.

5. When said principal shall be large enough to furnish the necessary sum to defray the said prizes, as stated in No. 4, the surplus income remaining after paying all the prizes awarded during the year shall be used by the President of the University to encourage oratory, debate, or any other object decided upon by the Faculty.

THE FRAZIER AND RINGER MEMORIAL FUND

This is a fund for the medical and surgical care of needy students, established in memory of Benjamin West Frazier, A.M., Sc.D., formerly Professor of Mineralogy and Metallurgy, and Severin Ringer, U.J.D., formerly Professor of Modern Languages and Literatures and of History, each of whom faithfully served Lehigh University for one-third of a century. The fund was started February 12, 1906, by the donation of $13,000 by the late Robert H. Sayre. It is the hope and expectation of the friends of the University that this fund may, by other donations, be increased in time to amount to a sum sufficient to insure free medical and surgical attendance to all students of the University requiring such aid.

STUDENTS

B.A.—Bachelor of Arts.
Bus.—Business Administration.
C.E.—Civil Engineering.
Ch.E.—Chemical Engineering.
Chem.—Chemistry.
E.E.—Electrical Engineering.
E.M.—Mining Engineering.
M.E.—Mechanical Engineering.
Met.—Metallurgy.
N.E.—Ship Construction and Marine Transportation.

The names in the following lists include all the students who have registered and attended recitations at the University for the current year.

GRADUATE STUDENTS

	For Degree	Residence
Anderson, Harold Victor, B.Ch.E., (*University of Michigan*)	M.S.,	Bethlehem.
Anderson, Rachel Evans, A.B., (*Wellesley College*)	M.S.,	Easton.
Barzun, Henri Martin, B. es L., (*University of Paris*)	M.A.,	Bethlehem.
Buckley, Malcolm Kee, B.S., (*Lehigh University*)	M.S.,	Allentown.
Burgess, Eugene Willard, B.S., (*Lehigh University*)	M.S.,	Joliet, Ill.
Carroll, Clara, B.A., (*Moravian College for Women*)	M.A.,	Bethlehem.
Carter, Wayne Hanley, B.S., (*Lehigh University*)	M.S.,	Bethlehem.
Coaklay, Maurice Thomas, Ch.E., (*Lehigh University*)	M.S.,	Easton.
Crow, Mary Matilda, B.A., (*Moravian College for Women*)	M.A.,	Bethlehem.
Everhart, William Alfred, A.B., (*Miami University*)	M.S.,	Granville, O.
Ewing, Boyd Ross, jr., B.A., (*Lehigh University*)	M.A.,	Bethlehem.
Farber, Hobart Amory, B.A., (*Lehigh University*)	M.A.,	Northampton.
Fink, William LeRoy, A.B., (*Ursinus College*)	M.A.,	Slatington.
Glentzer, Kenneth V., B.S., (*University of Indiana*)	M.S.,	Bethlehem.

Greider, Emma Cora, A.B., (*Hunter College*) M.A., Portland.

Gruber, Howard Dietrich, E.E., (*Lehigh University*) M.S., Bethlehem.

Harris, Sterling G., B.S., (*Pennsylvania State College*) M.A., Bethlehem.

Hofford, Hilda Naomi, B.A., (*Moravian College for Women*) M.A., Allentown.

Kistler, Paul N., B.S., (*Pennsylvania State College*) M.S., Bethlehem.

Kreidler, William Alfred, B.S., (*Lehigh University*) M.S., Bethlehem.

Kunkel, George A., A.B., (*Muhlenberg College*) M.A., Northampton.

Leach, Lester Lorraine, B.S., (*University of Missouri*) M.S., Bethlehem.

Lyle, George Averett, B.S., (*Hampden-Sidney College*) M.A., Bethlehem.

McKenzie, Carl Harry, B.S., (*Lehigh University*) M.S., Dallas, Texas.

Nordenholt, George Fred, M.E., (*Lehigh University*) M.S., Bethlehem.

Perkins, Wallace Wyman, A.B., (*Harvard University*) M.A., Bethlehem.

Philippides, John Argyrios, B.A., (*Lehigh University*) M.S., Easton.

Quast, Walter Flamm, M.E., (*Lehigh University*) M.S., Bethlehem.

Rau, Henry Brunner, B.S., (*Moravian College*) M.S., Bethlehem.

Riley, John D., B.S., (*University of Pennsylvania*) M.S., Allentown.

Ringleben, August Andrew, A.B., (*Ursinus College*) M.A., Hazleton.

Shedd, Thomas C., S.B., (*Brown University*) M.S., Phoenixville.

Shen, Dzu-Kun, M.S., Hankow, China.

Shimer, Lenore D., B.A., (*Smith College*) M.A., Bethlehem.

Shunk, Helen Marion, A.B., (*Moravian College for Women*) M.A., Bethlehem.

Smith, Norman E., A.B., (*Pennsylvania State College*) M.A., Slatington.

Snyder, J. W., A.B., M.A., (*Bucknell University*) M.A., Slatington.

Stewart, John Lammey, jr., B.S., (*Pennsylvania State College*) M.S., Bethlehem.

Strunk, Elvira M., B.S., (*Albright College*) M.S., Changsha, Hunan, China.

Talmage, Sterling Booth, B.S., (*University of Utah*) M.S., Salt Lake City, Utah.

Wetherhold, Mark Andrew, B.S., (*Muhlenberg College*) M.S., Allentown.

Wetherhold, Ralph Vitilas, B.S., (*Muhlenberg College*) M.S., Allentown.

Yeager, Howard James, A.B., (*Franklin and Marshall College*) M.A., Emaus.

Zell, Harry Allen, A.B., (*Franklin and Marshall College*) M.A., Bethlehem.

Zinszer, Harvey Alfred, B.A., (*Lehigh University*) M.A., Bethlehem.

Hobbs, Douglas Brown, B.A., (*University of the South*) Met., Live Oak, Fla.

Lloyd, Francis James, jr., B.A., (*St. John's College*) C.E., Pocomoke City, Md.

Villaume, Frederick Henry A.B., (*Columbia University*) E.M., New York, N. Y.

Smith, Alexander Forbes, jr., (*United States Naval Academy*) Spl.C.E., Reading.

SENIOR CLASS

Class of 1923

	Course	Residence
Abel, Stanford Edward,	C.E.,	Washington, D. C.
Acker, Swope,	E.E.,	Baltimore, Md.
Amig, William Van Wert,	M.E.,	Baltimore, Md.
Ancona, Frederick Bechtel,	E.E.,	Reading.
Appel, Carl Wilson,	E.E.,	Allentown.
Asbury, Thomas Henry, 2nd,	Bus.,	Philadelphia.
Bahnsen, Conrad Mortimer,	B.A.,	Nazareth.
Balderson, Robert Power,	Bus.,	Pittsburgh.
Barber, Frederick Edwin,	E.E.,	Allentown.
Barrall, John Kenneth,	B.A.,	Allentown.
Barrell, Robert Webb, jr.,	E.E.,	St. Louis, Mo.
Beale, Edward Belknap,	Ch.E.,	Washington, D. C.
Beck, Rodney Maurer,	Ch.E.,	Philadelphia.
Beitzel, Horace Clifton, jr.,	M.E.,	Moorestown, N. J.
Bessemer, Stephen Joseph,	Bus.,	Bethlehem.
Bieg, Henry Conrad,	E.M.,	Philadelphia.
Bishop, Charles Fletcher,	E.E.,	Williamsport.
Blankenbuehler, John Henry,	E.E.,	Elizabeth.
Bloch, Elmer Morton,	B.A.,	Newport, R. I.
Bobbin, Raymond Joseph,	Bus.,	Shenandoah.
Bodey, Carl Franklin,	E.E.,	Reading.
Borden, George Centennial, jr.,	Ch.E.,	Asbury Park, N. J.
Boyden, Wilson Gordon,	E.E.,	Greenwich, Conn.
Boyer, Willard Albert Solomon,	B.A.,	Lehighton.
Bradley, Clifton Newton,	Bus.,	Brooklyn, N. Y.
Bray, Lennox Jerome,	M.E.,	Westerly, R. I.
Brewer, Warren,	N.E.,	Newton Center, Mass.
Brotzman, Reginald Philip,	E.E.,	Easton.
Burgess, Charles Owen,	Met.,	Niagara Falls, N. Y.
Bush, Charles Roland, jr.,	C.E.,	Washington, D. C.
Callahan, George White Gregory, jr.,	C.E.,	Newport, R. I.
Camm, John Palmer,	E.M.,	Atlantic City, N. J.
Carey, James White, jr.,	M.E.,	Wenonah, N. J.
Carlisle, William Albert,	Bus.,	Luthersburg.
Chisholm, Henry Lewis, jr.,	M.E.,	Buffalo, N. Y.
Christman, Calvin Claude,	B.A.,	Lehighton.

Clarke, David Messer,	C.E.,	Bee Ridge, Fla.
Compher, Wilfred Clinton,	Bus.,	Poolesville, Md.
Conlin, John Francis, jr.,	Bus.,	Philadelphia.
Coxe, Edward Haviland, jr.,	E.E.,	Pittsburgh.
Creighton, Arthur Morgan,	Met.,	Bayonne, N. J.
Cusick, Arthur Cabot,	M.E.,	Roxbury, Mass.
Darsie, James Hazen,	E.M.,	West Homestead.
Davis, Edward Chester,	M.E.,	Taylor.
Day, Harrie Lyon,	Met.,	Ogdensburg, N. Y.
Decker, Everett Judd,	E.M.,	Mountain Lakes, N. J.
Dehnick, Joseph Albert,	C.E.,	Atlantic City, N. J.
DeMoyer, Frank Hart,	C.E.,	Camden, N. J.
DePuy, Stuart Walton,	Ch.E.,	Hammonton, N. J.
Derrick, Charles Luther,	E.E.,	Washington, D. C.
Desh, George Jacob,	B.A.,	Belfast.
Dithridge, Edward Hay,	Ch.E.,	Morrisville.
Dixon, Lyman LeRoy,	E.M.,	Flushing, N. Y.
DuBois, Howard Higbee,	E.M.,	Philadelphia.
Erb, John Edgar,	Met.,	Middletown.
Ertner, Harold Sigmond,	C.E.,	Camden, N. J.
Fancher, Charles Melvin,	N.E.,	Elizabeth, N. J.
Farace, Samuel,	E.E.,	Baltimore, Md.
Farkas, Harold,	Ch.E.,	Newark, N. J.
Fehr, Howard Franklin,	B.A.,	Bethlehem.
Ferguson, Frank Elliott, jr.,	E.E.,	Washington, D. C.
Ferris, Edwin Alden,	M.E.,	Ridgefield Park, N. J.
Ferry, John Francis,	E.E.,	Allentown.
Foot, Cyril Hughes,	M.E.,	Westfield, N. J.
Forney, Charles David,	E.E.,	Hanover.
Forstall, Charles Fletcher,	C.E.,	Rosemont.
Freeman, Carlos Alphonso,	E.M.,	Caracas, Venezuela.
Fuld, Melvin,	E.E.,	Baltimore, Md.
Garber, Meyer Isadore,	Ch.E.,	Norristown.
Gardy, Julian Washington,	Bus.,	Doylestown.
Gentzlinger, Henry Werner,	C.E.,	New York, N. Y.
Getz, David King,	B.A.,	Allentown.
Gihon, Harry David,	M.E.,	Trenton, N. J.
Glasmire, Frederick Wanner,	Ch.E.,	Bethlehem.
Graff, Richard Morris,	E.M.,	Worthington.
Green, Kenneth William,	E.E.,	Weissport.

Groff, Joseph Coblentz,	N.E.,	New York, N. Y.
Hacker, Robert Trost,	E.M.,	Toledo, O.
Hales, Ralph Alonzo,	Ch.E.,	Washington, D. C.
Handwerk, Erwin Casper,	E.M.,	Slate Dale.
Hardcastle, Edward,	E.E.,	Easton, Md.
Harkins, Linus Kenneth,	B.A.,	Homestead.
Hartung, Philip Halstead,	M.E.,	Yonkers, N. Y.
Hauck, Adam Edward,	E.M.,	Buffalo, N. Y.
Heikes, George Conrad,	B.A.,	Salt Lake City, Utah.
Hewitt, Alfred George,	Ch.E.,	Washington, D. C.
Hicks, Albert Willet, jr.,	E.M.,	Allentown.
Hitchner, Adam Hannan,	E.M.,	Woodbury, N. J.
Hoch, Albert Jackson,	Met.,	Reading.
Hoke, William Mason,	E.E.,	Lebanon.
Hornbostel, Lloyd,	M.E.,	Pittsburgh.
Huston, James Stewart,	Met.,	Coatesville.
Israel, Charles Henry, jr.,	Ch.E.,	Philadelphia.
Jacobson, Louis John,	C.E.,	Washington, D. C.
Johnston, Bryon Albert Chapman,	E.M.,	Tompkinsville, N. Y.
Kaman, Samuel Lawrence,	B.A.,	New York, N. Y.
Kehler, Lloyd Benjamin,	M.E.,	Shamokin.
Kennedy, Jamieson Douglas,	B.A.,	North Adams, Mass.
Kilbourn, Willam Robert,	M.E.,	Williamsport.
Killmer, Jack Kaufman,	Met.,	Reading.
Knodel, Charles Gotthilf,	M.E.,	Allentown.
Koch, George Schneider,	E.E.,	Washington, D. C.
Kocher, Walter Merritt,	C.E.,	Allentown.
Kramer, Allan Reuel,	E.E.,	Coplay.
Kratz, Wilbur,	M.E.,	Baltimore, Md.
Kreisel, John Werner,	B.A.,	Pen Argyl.
Kressler, Charles Horner,	E.E.,	Finesville, N. J.
Kurtz, Irwin Faust,	C.E.,	Pottstown.
Kutzleb, Richard, jr.,	M.E.,	Baltimore, Md.
Lambert, Tilghman Albert,	B.A.,	Bethlehem.
Larkin, Paul Revere,	C.E.,	Wallaston, Mass.
Larkin, Sylvester Makens,	C.E.,	Norristown.
Laughton, William Miller,	Met.,	Washington, D. C.
Lebovitz, Samuel Llewellyn,	E.M.,	Baltimore, Md.
Lees, John Luther,	C.E.,	Hellertown.

Leister, Frank Henry, jr.,	C.E.,	North Wales.
Lewis, Frederick William,	B.A.,	Pottsville.
Light, Joel Longenecker,	E.M.,	Allentown.
Lodge, Friend Horace,	C.E.,	Philadelphia.
McConnell, George D.,	Bus.,	Butler.
McFadden, Michael Charles Joseph,	Met.,	Bethlehem.
McPherson, John Douglas, 3rd,	E.E.,	Fair Oaks, Cal.
Magruder, Elbert Tyler,	M.E.,	Winchester, Va.
Mattson, William Raymond,	C.E.,	Rockledge.
Mecaslin, Harry Benton, jr.,	E.E.,	Baltimore, Md.
deMenezes, Godofredo Moraes,	C.E.,	Aracaju, Sergipe, Brazil.
Miller, Charles Heck,	Ch.E.,	Philadelphia.
Minnich, Charles Raymond,	C.E.,	Robesonia.
Minnich, Joseph Pilkay,	E.E.,	Harrisburg.
Mitman, Frederick Snyder,	E.M.,	Bethlehem.
Mitman, Harry Ammon,	Ch.E.,	Northampton.
Molloy, James Xavier,	N.E.,	Bridgeport, Conn.
Moyer, Joseph Fretz,	C.E.,	Quakertown.
Muirhead, Andrew Wilson,	M.E.,	Bridgeport, Conn.
Muschlitz, Wilbert David,	B.A.,	Bethlehem.
Muzdakis, John Robert,	E.E.,	Baltimore, Md.
Nadig, Stanton Elwell,	N.E.,	Allentown.
Nevins, Samuel Craig,	Ch.E.,	Tamaqua.
Newlin, James Memmert,	E.M.,	Sparrows Point, Md.
O'Keefe, Francis Callistus,	Bus.,	Rockville, Conn.
Olcott, John Hedrick,	C.E.,	Glencarlyn, Va.
Old, Marcus Calvin,	B.A.,	Allentown.
Opdycke, John Hinkle,	Bus.,	Philadelphia.
Petersen, Theodore Otto,	Ch.E.,	Philadelphia.
Pfahler, Robert Gair,	E.M.,	Wilkes-Barre.
Picht, George Christopher, jr.,	E.E.,	Bethlehem.
Pill, Frank, jr.,	B.A.,	Califon, N. J.
Quick, Donald Mott,	M.E.,	Yonkers, N. Y.
Quier, Kenneth Elwell,	M.E.,	Bethlehem.
Randall, Harradon Reets,	E.M.,	Shamokin.
Read, John Mason,	C.E.,	Washington, D. C.
Redington, Joseph Patrick,	Bus.,	Wilkes-Barre.
Regad, Eugene Desire,	E.E.,	Irvington, N. J.

Reiter, Irvin Sterner,	Met.,	Bethlehem.
Rhoades, Ronald Sage,	E.M.,	Nutley, N. J.
Rhoads, Byron Elmer, jr.,	C.E.,	Big Stone Gap, Va.
Richards, Elmer Lincoln, jr.,	C.E.,	Somerville, N. J.
Rieman, Edwin Frederick,	E.E.,	Tamaqua.
Riley, John Stephen,	E.E.,	Willimantic, Conn.
Robinson, John Bunyan,	E.M.,	Chester.
Roller, Oscar Frederic, jr.,	Ch.E.,	Philadelphia.
Rubba, Russell,	Ch.E.,	Hammonton, N. J.
Ruger, Raymond Philip,	C.E.,	Philadelphia.
Sansom, Edward Marsh,	Ch.E.,	Cranford, N. J.
Schaefer, Everett Gordon,	Ch.E.,	New York, N. Y.
Schifreen, Clement Solomon,	E.E.,	Catasauqua.
Schragger, Charles Nelson,	Ch.E.,	Trenton, N. J.
Schrauff, Henry John,	E.M.,	Jersey City, N. J.
Schwab, Thomas Wesley, jr.,	B.A.,	Bath.
Schwarzbach, Alvin August Claus,	E.M.,	Newark, N. J.
Sheetz, Olin Curtis,	Met.,	Philadelphia.
Shoemaker, Lewis Foulke, jr.,	C.E.,	Devon.
Siemann, Arthur Louis,	C.E.,	Brooklyn, N. Y.
Smith, Hubert Bell,	C.E.,	Philadelphia.
Smith, Thomas Cameron,	M.E.,	Allentown.
Snyder, Edwin Henry, jr.,	E.E.,	Washington, D. C.
Stanier, John Stewart,	Bus.,	Tarentum.
Stanley, Leslie Wright,	B.A.,	Williamsport.
Stanton, Thomas William,	Bus.,	Montclair, N. J.
Steiner, William Joseph Henry,	Bus.,	New York, N. Y .
Taylor, John Wright, jr.,	M.E.,	Century, Fla.
Thomas, John Archibald,	E.M.,	Scranton.
Thompson, William Gardiner,	E.M.,	Richmond Hill, N. Y.
Tilghman, Richard Haughton,	M.E.,	Overlea, Md.
Todd, James Arnold,	Ch.E.,	Doylestown.
Underwood, Herbert Francis,	M.E.,	Brooklyn, N. Y.
Van Billiard, Lewis Howard,	E.E.,	Bethlehem.
Van Keuren, Edwin,	B.A.,	Bethlehem.
Van Ness, John Harold,	C.E.,	Paterson, N. J.
Voss, Charles Abbott,	Bus.,	Brooklyn, N. Y.
Walker, Percy Franklin,	C.E.,	Harrisburg.
Wallace, Edward Allen, jr.,	Bus.,	Grand Rapids, Mich.

Walters, Frank Clayton,	N.E.,	Bethlehem.
Walters, George Wilmer,	E.M.,	Cazenovia, N. Y.
Walton, Joseph Edward,	C.E.,	Bethlehem.
Webb, Robert Stanford,	M.E.,	Asheville, N. C.
Wentz, James,	Bus.,	New York, N. Y.
Werner, David Thomas,	E.E.,	Lebanon.
Wight, Donald Miller,	M.E.,	Washington, D. C.
Wilkins, Paul Edwin,	C.E.,	Baltimore, Md.
Wingate, Bruce Kuglow,	C.E.,	Reading.
Wire, Charles Raymond,	C.E.,	Washington, D. C.
Wolensky, Barney Louis,	Bus.,	Palmerton.
Wuetrich, Adolph Gustave,	Met.,	Perth Amboy N. J.
Yeide, Harry Elwood,	E.E.,	Weatherly.

JUNIOR CLASS

Class of 1924

	Course	Residence
Abel, George Justin,	M.E.,	Elizabeth, N. J.
Adams, Edgar Thomas, jr.,	E.M.,	Crafton.
Alford, Charles Mahin,	E.E.,	East Orange, N. J.
Allan, Robert Houston,	Bus.,	Jermyn.
Alwine, Charles Emory,	E.E.,	New Oxford.
Ayers, William DeWitt,	C.E.,	Branchville, N. J.
Baker, Ernest Wellington,	E.E.,	Harrisburg.
Benner, Ralph Chalfont,	M.E.,	Atglen.
Bennett, Edmund Van Gilder,	Met.,	Lansdale.
Bishop, Morris Earl,	B.A.,	Bethlehem.
Boggs, George Warren,	Bus.,	Melrose Park.
Bond, Louis Boutell,	M.E.,	Philadelphia.
Bond, Luther Gerber, jr.,	M.E.,	York.
Bonney, Henry Ernest,	B.A.,	Pen Argyl.
Bortz, Carl Martin,	Bus.,	Pittsburgh.
Boyd, James Andrew,	Bus.,	Montvale, N. J.
Boyle, Joseph, jr.,	Bus.,	Paterson, N. J.
Bridegam, Warren James,	E.E.,	Reading.
Brookfield, Frederic	Met.,	Syracuse, N. Y.
Buck, Richard Joseph,	B.A.,	Bethlehem.
Bugbee, Jesse Albert,	C.E.,	Trenton, N. J.
Bumbaugh, Frank Taylor,	Met.,	Monessen.
Burt, Paul Shafter,	Bus.,	Washington, D. C.

Campbell, Paul Frederick,	C.E.,	Swedesboro, N. J.
Campbell, William Brunner,	Bus.,	Lebanon.
Canavan, William Paul,	B.A.,	Chester.
Carol, José Maria,	C.E.,	Cardenas, Cuba.
Carpenter, Henry Bartleson, jr.,	M.E.,	Montclair, N. J.
Carter, Norman Campbell,	Chem.,	Phoenixville.
Chang, Kuang-Ming,	Met.,	Shanghai, China.
Cluthe, Carl, 3rd,	Bus.,	Glen Ridge, N. J.
Coleman, Douglas Fleming,	B.A.,	Jersey City, N. J.
Conley, Thomas George, jr.,	E.M.,	Pittsburgh.
Cornelius, Charles Taylor,	M.E.,	Pittsburgh.
Cornelius, George Emil Wagner,	Bus.,	McKeesport.
Cottman, Llewellyn Powell,	Ch.E.,	Baltimore, Md.
Craig, Thomas Benneville,	M.E.,	Slatington.
Cupp, Laylon Lavern,	M.E.,	Williamsport.
Danko, John Vincent,	E.M.,	Port Chester, N. Y.
Davis, William Shaff, jr.,	E.M.,	Lebanon.
Degnan, James Michael, jr.,	E.E.,	Bethlehem.
DiBiase, James,	Bus.,	Newark, N. J.
Dick, Donald Benner,	Bus.,	Hazleton.
Diener, Walter Miller,	M.E.,	Hamburg.
Dietrick, Robert Charles,	B.A.,	High Bridge, N. J.
Dietz, Joseph Budding,	Ch.E.,	Lancaster.
DiGuilian, Attilio Peter,	C.E.,	Washington, D. C.
Donaldson, Kenneth,	C.E.,	Washington, D. C.
Drake, William Robert,	C.E.,	Reading.
Edson, Warren Newton,	C.E.,	Scranton.
Emanuel, Robert Samuel,	M.E.,	Nesquehoning.
Emerson, Ralph Waldo,	B.A.,	Ridgefield Park, N. J.
Ennis, Robert William,	C.E.,	Mount Penn.
Fegley, Claud Andrew,	B.A.,	Bethlehem.
Fleck, Paul Butler,	E.M.,	Pittsburgh.
Focht, Louis Doster,	E.M.,	Trenton, N. J.
Foster, Arthur Lee,	E.E.,	Allentown.
Fritzsche, Otto Herbert Adolph,	C.E.,	Irvington, N. J.
Galloway, Beverly Stewart,	B.A.,	Takoma Park, D. C.
Ganey, Thomas Vincent,	Bus.,	Bethlehem.
Gee, Elisha, jr.,	B.A.,	Denver, Col.
Gerhart, Paul Leroy,	E.E.,	Reading.
Glen, Maxwell,	Bus.,	Newbury, Mass.

Gorham, Edward Werrey,	Ch.E.,	Brooklyn, N. Y.
Grace, Carroll Brewster, jr.,	M.E.,	Philadelphia.
Graham, George Tinsley,	Bus.,	Bethlehem.
Grambs, George Lorenzo,	B.A.,	Scranton.
Greer, Harry Ross,	B.A.,	Atlanta, Ga.
Grim, James Stewart, jr.,	E.E.,	Kutztown.
Hagenbuch, Edward Allen, jr.,	E.E.,	Allentown.
Hampton, George,	Ch.E.,	Bridgeton, N. J.
Harper, Robert Malcolm,	Bus.,	Butler.
Hartmann, Edward Paul,	Met.,	Bethlehem.
Hauser, Roderick Ritter,	Bus.,	Allentown.
Hauser, Stanley LeRoy,	Met.,	Kutztown.
Hawkins, Richard Arthur,	E.M.,	Forty Fort.
Heckert, Robert Augustus,	B.A.,	Brackenridge.
Heimbrook, Charles Albert,	Bus.,	Bethlehem.
Hendrickson, Francis Lynn,	E.M.,	Woodbury, N. J.
Henry, Eugene Harvey, jr.,	C.E.,	Lancaster.
Henschen, Leroy,	E.E.,	Baltimore, Md.
Heske, Walter Gottlieb,	Met.,	Bethlehem.
Hewson, Edward Haskell,	N.E.,	Madison, N. J.
Hiller, Charles Francis,	B.A.,	Buchanan, Mich.
Hoagland, Dan Parmlee, jr.,	B.A.,	Bayonne, N. J.
Hoffman, William Jacob,	B.A.,	Raubsville.
Homeyer, William Henry,	B.A.,	Jersey City, N. J.
Hopkins, George Whitefield,	M.E.,	Cleveland, O.
Hottinger, Alwin Julius,	Met.,	Kenvil, N. J.
Howell, Richard Paulmier,	E.M.,	Bethlehem.
Huggins, George Allen,	Bus.,	Fanwood, N. J.
Hunter, Francis Alexander,	M.E.,	Hoboken, N. J.
Jamieson, John Jay Ivory,	Met.,	Frackville.
Jamison, Earl Helmes,	M.E.,	Hazleton.
Jenkins, George French,	E.M.,	Binghamton, N. Y.
Johnson, Alfred William,	E.E.,	West Hartford, Conn.
Johnson, Sidney Edward,	Bus.,	Dayton, O.
Jones, Gordon Tyron,	B.A.,	Edwardsville.
Kasper, Ralph Joseph,	N.E.,	Ridgefield, Conn.
Kemmerer, Walter William,	B.A.,	Wind Gap.
Kichline, William Levi,	B.A.,	Bethlehem.
Kiefer, Herman Eugene, jr.,	C.E.,	Quincy, Ill.
Kitchen, John C., jr.,	Ch.E.,	Columbia, N. J.

Klein, Walter Conrad,	B.A.,	Pottsville.
Klippel, Earl Frederick,	E.E.,	Bethlehem.
Knouse, Walter Earl,	E.E.,	Washington.
Kravitz, Raphael,	E.M.,	Atlantic City, N. J.
Langfitt, James Porter,	B.A.,	Parkersville, W. Va.
Laux, George August,	M.E.,	Baltimore, Md.
Laux, Louis Albert,	M.E.,	Baltimore, Md.
Levy, Bertram Rich,	E.E.,	Brooklyn, N. Y.
Lewis, John Herbert,	C.E.,	North Wales.
Light, Berlin Carl,	Ch.E.,	Reading.
Linaberry, Stanley Simrell,	C.E.,	Columbia, N. J.
Lingle, Charles Fitting,	Bus.,	Harrisburg.
Litke, Harry Theodore,	C.E.,	Millville, N. J.
Long, Willoughby James,	Met.,	Bethlehem.
Lord, Edward Thomas Warren,	Ch.E.,	Philadelphia.
Luce, Donald Cameron,	E.E.,	Scranton.
MacKenzie, Adrian Morell,	Bus.,	Englewood, N. J.
McBride, John Leo,	B.A.,	Phillipsburg, N. J.
McBride, Joseph Aloysius,	M.E.,	Philadelphia.
McIntire, Robert Lester,	Bus.,	Butler.
Mackenzie, Sidney Thompson,	N.E.,	Philadelphia.
Maguire, Joseph Anthony,	B.A.,	Vineland, N. J.
Major, William Samuel,	Ch.E.,	Roebling, N. J.
Mandell, Leon Nathaniel,	Ch.E.,	Philadelphia.
Martin, Frederic Thurman,	Ch.E.,	Harrisburg.
Master, Warren S.,	E.E.,	Reading.
Maxwell, Thomas,	E.E.,	Baltimore, Md.
Mechling, John Younkins,	M.E.,	Casper, Wyo.
Mellinger, Albert Charles, jr.,	B.A.,	Bethlehem.
Mercur, Robert Sayre,	E.M.,	Harrisburg.
Metzner, Russell Henry,	M.E.,	Wheeling, W. Va.
Meyer, William Charles,	E.E.,	Bethlehem.
Miller, Philip Robert,	B.A.,	Bethlehem.
Miller, William Hurxthal,	E.E.,	Glendale, O.
Milligan, John Ralph,	Bus.,	East Liverpool, O.
Minster, Pemberton Foster,	Bus.,	Bristol.
Mitchell, Charles Bayard, 2nd,	E.M.,	Woodbury, N. J.
Moore, Myron Turner,	Bus.,	Youngstown, O.
Morgan, Josiah Dodson,	E.E.,	Allentown.
Morgan, William John,	Bus.,	Bethlehem.

Northup, Maynard Sanborn,	Met.,	Allentown.
Palmer, Henry Parsons,	C.E.,	Langhorne.
Parker, Joseph Henry,	Bus.,	Milwaukee, Wis.
Parsons, Donald Adelbert,	M.E.,	New Rochelle.
Patterson, John Alexander, jr.,	Ch.E.,	Philadelphia.
Paxton, George Benjamin,	E.E.,	Harrisburg.
Pearson, Frederick Joseph,	B.A.,	Wilkes-Barre.
Penwell, Max Kenneth,	E.M.,	Pana, Ill.
Piersol, John Marshall,	E.M.,	Philadelphia.
Platt, Robert,	Ch.E.,	Westfield, N. J.
Plumb, Rollo Green,	B.A.,	Bethlehem.
Quinlan, Eldridge Edward,	Bus.,	Newark, N. J.
Rakestraw, Theodore Horace,	E.M.,	Mechanicsburg.
Ratajczak, Frank Xavier,	E.E.,	Reading.
Redline, Paul Wilson,	E.M.,	Bethlehem.
Reese, Benjamin Harvey,	Bus.,	Kingston.
Reilly, John Kennedy,	Bus.,	Spangler.
Reyer, William Aaron,	Ch.E.,	Northampton.
Reynolds, Joseph Lee,	E.M.,	Kingston.
Rice, Charles Lewis,	C.E.,	Hazleton.
Rice, Janvier Mayhew,	E.E.,	Bridgeton, N. J.
Richards, Louis Moore,	M.E.,	Somerville, N. J.
Richardson, Edward Hardy,	C.E.,	Malvern.
Ritter, Ralph Shelly,	E.E.,	Quakertown.
Roberts, Arthur Parsons,	Bus.,	Englewood, N. J.
Robinson, Edmund Lewis,	E.E.,	Bethlehem.
Robinson, Harry George,	M.E.,	Trenton, N. J.
Robinson, John Mealy,	M.E.,	Pittsburgh.
Rogers, Henry Gordon,	Ch.E.,	Newark, N. J.
Rogers, John Frederick,	Bus.,	Buffalo, N. Y.
Rohrer, Henry Augustus,	M.E.,	Lancaster.
Ross, Jack Elton,	C.E.,	Newark, N. J.
Rouch, Ernest Allen,	M.E.,	York.
Ryan, Michael Joseph, jr.,	B.A.,	Bethlehem.
Sanford, James Leo,	B.A.,	Long Beach, N. Y.
Sattenstein, Sidney Lincoln,	E.E.,	Reading.
Saunders, Oliver Hubbard, jr.,	M.E.,	Brooklyn, N. Y.
Sayre, Austin Bartholomew,	B.A.,	Glen Ridge, N. J.
Schaffer, George Washington,	Met.,	Allentown.
Scheetz, Edwin Freed,	E.M.,	Wyncote.

Schleicher, Wallace Mengel,	N.E.,	Maplewood, N. J.
Schultz, Albert Novinger,	E.E.,	Williamsport.
Schwartz, Paul Englehart,	Bus.,	Harrisburg.
Settle, Richard Torpin,	E.M.,	Drexel Hill.
Shigo, John Joseph, jr.,	B.A.,	Hazleton.
Simmons, John Stegner,	E.M.,	Scranton.
Skeels, Walter Simeon,	E.M.,	Rochester, N. Y.
Smith, Leslie Ewart,	E.M.,	East Mauch Chunk.
Snyder, Amandus Deischer, jr.,	Ch.E.,	Pennsburg.
Snyder, Frederick Deppen,	Ch.E.,	Harrisburg.
Springsteen, Arthur Wellington,	B.A.,	Detroit, Mich.
Springsteen, William Watson,	Bus.,	Detroit, Mich.
Stauffer, Edwin Lewis,	Ch.E.,	Northampton.
Stern, Paul Hertzler,	B.A.,	Elizabethtown.
Stille, Francis Carroll,	E.M.,	Woodbury, N. J.
Strawn, Eli Howard,	C.E.,	Quakertown.
Swartley, John Cassel, jr.,	B.A.,	Doylestown.
Swartz, Ralph Christian,	M.E.,	Allentown.
Talmage, Herbert Richard,	C.E.,	Irvington, N. J.
Thayer, James Stansbury,	M.E.,	Baltimore, Md.
Thompson, Walter Scott,	E.E.,	Sunbury.
Tonking, Russell,	Ch.E.,	Dover, N. J.
Troland, Hugh More, jr.,	C.E.,	Philadelphia.
Troutman, Roy Ezra,	Ch.E.,	Bethlehem.
Tuggey, John Mitchell, jr.,	B.A.,	Bethlehem.
Underwood, Ralph Edward,	B.A.,	Brooklyn, N. Y.
Urban, Stanley Joseph,	E.M.,	Allentown.
Van Dyke, John Harrison,	M.E.,	Pittsburgh.
Warriner, Ruel Dexter,	E.M.,	Philadelphia.
Wasser, Floyd Henry,	Met.,	Bethlehem.
Wehrenberg, William, jr.,	E.E.,	Baltimore, Md.
Wentz, Graham,	Ch.E.,	Scranton.
Werft, Ellis Lincoln,	E.M.,	Altoona.
Wiegner, Andrew Newton,	C.E.,	Bethlehem.
Wood, Arthur,	B.A.,	Providence, R. I.
Woodrow, Maurice Orr,	C.E.,	Wilkes-Barre.
Wooldridge, William Potter,	E.M.,	Pittsburgh.
York, Warren Webster,	Bus.,	Scranton.
Yuan, Tung,	E.M.,	Pekin, China.
Zannaras, John Phillip,	N.E.,	Chios, Greece.

SOPHOMORE CLASS

Class of 1925

	Course	Residence
Adams, Robert Burnette,	Bus..	Brockton, Mass.
Akialis, Joseph Michael,	Ch.E.,	Newark, N. J.
Allen, Charles Wesley,	E.M.,	Reading.
Allen, Walter Rue,	E.E.,	East Orange, N. J.
Angulo, David,	C.E.,	Barranquilla, Colombia, S. A.
Astarita, Francis Sandford,	Bus.,	Loch Arbor, N. J.
Austin, James Bliss,	Ch.E.,	Chicago, Ill.
Ayres, Clarence Cornelius,	E.E.,	Chester.
Barnes, John Francis,	E.M.,	New Paltz, N. Y.
Barton, Frederick Charles, jr.,	Bus.,	Tenafly, N. J.
Batz, Kenneth William Yates,	M.E.,	Stapleton, N. Y.
Bayles, Allison Lerch,	M.E.,	Charleston, S. C.
Beck, Frederick Charles,	E.E.,	Philadelphia.
Beggs, Charles Wendell,	Ch.E.,	Wilkinsburg.
Behr, William John, jr.,	N.E.,	Montclair, N. J.
Berg, Frederick Christian,	N.E.,	Philadelphia.
Bergen, Howard Beekman,	E.E.,	Newtown.
Bergen, Lewis Spaden,	E.M.,	Matawan, N. J.
Berger, Francis Joseph,	E.E.,	Wilkes-Barre.
Bevan, James Elmer,	E.E.,	Frackville.
Bidwell, James Truman,	B.A.,	Portland, Ore.
Binkley, Edward Lehman,	E.E.,	Hagerstown, Md.
Bokum, William Harold,	E.E.,	Philadelphia.
Borda, Russell Berger,	Bus.,	Schuylkill Haven.
Borden, Robert Oswald,	M.E.,	Bentonville, Va.
Bowman, John Gheen,	C.E.,	Bethlehem.
Britt, Therman Paul,	Bus.,	Rydal.
Brooks, Charles Emery,	M.E.,	Glen Ridge, N. J.
Brown, Ernest Embich,	E.E.,	Lebanon.
Brown, Merritt Weaver,	B.A.,	Bethlehem.
Bunn, George William,	B.A.,	East Stroudsburg.
Burke, Edmund Michael,	C.E.,	West Pittston.
Burnes, William Ryan,	C.E.,	Port Chester, N. Y.
Burton, John Taylor,	C.E.,	Philadelphia.
Callow, Michael John,	Met.,	New York, N. Y.
Campbell, Andrew Hiester,	C.E.,	Pottstown.

Castleman, Francis Lee, jr.,	B.A.,	Philadelphia.
Chambers, Harold Bair,	Met.,	Lancaster.
Cheel, Robert Duncan,	M.E.,	Ridgewood, N. J.
Cohen, Milford Hersh,	Ch.E.,	Charleston, W. Va.
Colclough, William Frederick, jr.,	B.A.,	Catasauqua.
Cook, Nevin John,	B.A.,	Drums.
Cottrell, Joseph Donald,	Ch.E.,	Takoma Park, D. C.
Coulton, John Marshall,	C.E.,	Red Bank, N. J.
Craig, John Horner,	Ch.E.,	Slatington.
Croll, John Harold,	E.M.,	Steelton.
Curtis, Edward Aloysius,	E.E.,	Lambertville, N. J.
Davis, James Hornor, 2nd,	B.A.,	Clarksburg, W. Va.
Davis, Richard Light,	E.M.,	Lebanon.
Day, Hugh Taylor,	B.A.,	Philadelphia.
Deck, Ausben Riege,	Ch.E.,	Dover, N. J.
Dickinson, Ansel Reed,	E.E.,	East Whately, Mass.
Dietrich, Horace Wilcox,	C.E.,	Baltimore, Md.
Dinkey, Charles Eugene, jr.,	E.M.,	Pittsburgh.
Dorton, Frederick Babcock,	B.A.,	Baltimore, Md.
Douglass, Norman Engleman,	Chem.,	Ambridge.
Drury, William George,	C.E.,	West Pittston.
DuBois, Allen Corson,	B.A.,	Clayton, N. J.
Dykes, Henri Victor de Puis,	B.A.,	Bethlehem.
Eckfeldt, James Trousselle,	E.M.,	Bethlehem.
Egolf, Harry Louis, jr.,	E.M.,	Philadelphia.
Elicker, Charles Robert,	B.A.,	Roselle Park, N. J.
Elmer, Robert William,	E.E.,	Bridgeton, N. J.
Entrekin, Paul Britton,	E.E.,	Swarthmore.
Everhart, John Lawrence,	Ch.E.,	Bethlehem.
Ewart, Roswell Horr,	Ch.E.,	North Plainfield, N. J.
Feick, Rufus Daniel,	Ch.E.,	Kutztown.
Finegan, Paul James,	B.A.,	Burlington, N. J.
Fister, Lee Harold,	E.E.,	Reading.
Flory, Curtis Bertram, jr.,	Bus.,	Forest Hills, N. Y.
Forsyth, William Redway,	C.E.,	Trenton, N. J.
Frey, Frank Gustave,	M.E.,	Baltimore, Md.
Franco, Carlos Alberto,	M.E.,	Barranco, Peru.
Fullard, William George,	B.A.,	Brooklyn, N. Y.
Gairns, William Otto,	Ch.E.,	La Grange, Ill.
Gallagher, Charles Barto,	B.A.,	New York, N. Y.

Garbarino, Stephen Lawrence,	Bus.,	Shenandoah.
Garra, Edward Joseph,	B.A.,	White Haven.
Geho, Charles Henry,	Ch.E.,	Hazleton.
Gibson, Kenneth Durward,	Bus.,	Belleville, N. J.
Glenn, Joseph Wooderson, jr.,	E.M.,	Garden City, N. Y.
Gondos, Robert Zoltan,	Ch.E.,	Reading.
Green, Thomas Edgar,	Bus.,	Butler.
Greene, Henry Eckford, jr.,	Bus.,	Amsterdam, N. Y.
Greer, William Chamberlain, jr.,	Bus.,	Woodbury, N. J.
Groner, Stephen Sheldon,	Bus.,	Syracuse, N. Y.
Gruhn, Arthur Max,	Bus.,	Brooklyn, N. Y.
Gutierrez, Francisco,	M.E.,	Mexico City, Mexico.
Gyourko, Joseph Edward,	M.E.,	Eckley.
Harmon, Herbert Greasen,	E.M.,	Ridgewood, N. J.
Harris, Abraham Buckley,	Ch.E.,	Baltimore, Md.
Hay, Erroll Baldwin, jr.,	M.E.,	Philadelphia.
Hess, Howard Samuel, jr.,	Bus.,	Hellertown.
Holzshu, Charles David,	E.E.,	Cumberland, Md.
Horn, Franklin Lefever,	Bus.,	Allentown.
Howland, George Asbury,	Ch.E.,	Asbury Park, N. J.
Hursh, James Sharpe,	N.E.,	Newville.
Hutchinson, Stuart Buckler,	C.E.,	Bethlehem.
Ingols, Heber Ashe,	Ch.E.,	Newark, N. J.
Isaacs, Kenneth Lothaire,	M.E.,	Scranton.
Jarrett, George Burling,	C.E.,	Haddonfield, N. J.
Jones, Edwin Pitchford, 2nd,	Bus.,	Bellevue.
Jones, William Joseph, jr.,	E.M.,	Narberth.
Keating, Miles James,	Bus.,	Bethlehem.
Keim, John Kenneth,	M.E.,	Bethlehem.
Keller, Edwin Walker,	B.A.,	Allentown.
Keller, Francis Randolph,	E.E.,	Allentown.
Kerr, Harry Knight,	Ch.E.,	Philadelphia.
King, Arthur Stanley,	M.E.,	Toms River, N. J.
Kingham, Laurence Brewster,	Bus.,	East Orange, N. J.
Kinzie, Raymond Horatio,	C.E.,	Tamaqua.
Kirchner, Earl Lorenz,	Ch.E.,	Washington, D. C.
Kittinger, Spencer Colie,	Bus.,	Buffalo, N. Y.
Koegler, George Franz,	B.A.,	New York, N. Y.
Krazinski, Leo Charles,	E.E.,	Mahanoy City.
Krellberg, Alfred,	Bus.,	New York, N. Y.

Lambert, Ralph Arthur,	E.M.,	Bethlehem.
Lang, Elheim,	Ch.E.,	Phoenixville.
Law, James Graham,	Ch.E.,	Bloomsburg.
Lawall, Paul,	E.M.,	Catasauqua.
Leavens, William Barry, jr.,	E.E.,	Maplewood, N. J.
Lee, Russell Werner,	Ch.E.,	Ottawa, Ill.
Leib, James Fulton,	Bus.,	Baltimore, Md.
Lerch, Franklin Stuart,	B.A.,	Freemansburg.
Leshefka, George John,	E.E.,	McAdoo.
Levitz, Max,	Bus.,	New York, N. Y.
Levy, Maurice Bert,	Met.,	Hazleton.
Lewis, Robert,	Bus.,	New York, N. Y.
Ludwig, Edward Henry Barthold,	Ch.E.,	Tompkinsville, N. Y.
Lundberg, George Otto,	M.E.,	Lansing, Mich.
MacFate, Robert Preston,	Ch.E.,	Bethlehem.
McDermott, James Francis,	Bus.,	New York, N. Y.
McKee, John Edwin,	Ch.E.,	Newport.
McKenzie, Alfred Crane,	N.E.,	Brooklyn, N. Y.
McMorris, William Barnhart,	C.E.,	Harrisburg.
McWilliams, Charles Anthony, Sinclair,	N.E.,	New York, N. Y.
Malis, Pincus Robert,	Bus.,	New York, N. Y.
Mann, Lynn Birckhead,	Bus.,	Woodcliff, N. J.
Mayberry, Harold,	Bus.,	Mahanoy City.
Metten, William Murray,	Bus.,	Wilmington, Del.
Michelson, Joseph Percy,	B.A.,	Bethlehem.
Miller, Howard Frederick,	M.E.,	Easton.
Miller, Meyer Morton,	E.M.,	Baltimore, Md.
Moran, Eugene Francis, jr.,	N.E.,	Brooklyn, N. Y.
Moreland, Lester Duane,	M.E.,	Trenton, N. J.
Moritz, George Robert,	Met.,	Allentown.
Myers, John Alfred,	M.E.,	York.
Neely, Frank Rodgers,	B.A.,	Pittsburgh.
Nehemiah, Maurice Albert,	Ch.E.,	Brooklyn, N. Y.
Nicholls, Edward Samuel,	Ch.E.,	Bethlehem.
Nicola, Oliver Peter, jr.,	E.M.,	Pittsburgh.
Noerr, Robert Collyer, jr.,	Ch.E.,	Hartford, Conn.
Norton, Robert Osgood,	M.E.,	South Orange, N. J.
O'Brien, William Coleman,	E.E.,	Washington, D. C.
O'Brien, William Henry, jr.,	Bus.,	Lynbrook, N. Y.

Ogden, John Boyd,	M.E.,	Johnstown.
Orr, Earl Haas,	Met.,	Lansdale.
Palmer, Arthur Carl,	C.E.,	East Orange, N. J.
Palmer, Herbert William,	B.A.,	Pen Argyl.
Parker, Norman Douglas, jr.,	E.E.,	Washington, D. C.
Patrick, Paul David,	E.E.,	Philadelphia.
Patterson, Daniel Walter,	C.E.,	Bethlehem.
Patty, Claibourne Watkins,	E.M.,	Little Rock, Ark.
Pharo, Homer Durand,	Ch.E.,	Bayonne, N. J.
Philips, Harry Kenneth,	Bus.,	Glen Ridge, N. J.
Pineda, Luis Guillermo,	E.E.,	Maracaibo, Venezuela.
Pittenger, Harry Joseph,	E.M.,	Bethlehem.
Pitts, Reginald Shatswell,	Chem.,	Hanover.
Platt, Ellis Halsted,	B.A.,	Washington, D. C.
Platt, Worthington Elmore,	E.M.,	New Haven, Conn.
Polatchek, Jerome Julius,	E.M.,	New York, N. Y.
Porter, Clarence Henry,	M.E.,	Washington, D. C.
Purdy, Victor Moreau,	Met.,	Brooklyn, N. Y.
Rankin, Bryant Loose,	Met.,	Reading.
Ransom, James Dudley,	B.A.,	Jersey City, N .J.
Reid, William Alexander,	M.E.,	Glen Ridge, N. J.
Rice, Hugh Banker,	C.E.,	Roanoke, Va.
Roberts, Carlton Mitchell,	B.A.,	Asbury Park, N. J.
Roberts, Paul Eagon,	B.A.,	Parkersburg, W. Va.
Roecker, Earl Edward,	E.M.,	Phillipsburg, N. J.
Roesch, Alfred Richard,	M.E.,	Jenkintown.
Rorabaugh, Merrill Schaeffer,	E.E.,	New Kensington.
Ross, Rodney Wyckoff,	Bus.,	Asbury Park, N. J.
Rostow, Lawrence,	Ch.E.,	Newark, N. J.
Roth, Milton Samuel,	B.A.,	Butler.
Rowley, Thomas Clarence,	Met.,	New York, N. Y.
Samuels, Fred Herman,	B.A.,	Newark, N. J.
Saxtan, Eugene Harris,	Bus.,	Jersey City, N. J.
Schmoll, Gilbert Henry,	Ch.E.,	Hazleton.
Schneider, Robert Siis,	M.E.,	Richmond Hill, N. Y.
Schock, Harvey Harold,	Ch.E.,	Shartlesville.
Seeley, Robert Inglis,	C.E.,	Keansburg, N. J.
Senior, Palmer Newman,	E.M.,	Bridgeport, Conn.
Serrell, Arthur Harold, jr.,	M.E.,	Brooklyn, N. Y.
Shartle, John Herbert,	C.E.,	Lancaster.

Sholes, Charles Latham,	Bus.,	Short Hills, N. J.
Siebert, John Carl,	Met.,	Bethlehem.
Siegmund, Harry Loew,	Ch.E.,	Harrisburg.
Smith, Morris Sparhawk,	M.E.,	Swarthmore.
Smith, Walter Reynolds,	M.E.,	Carbondale.
Snyder, Martin Edgar,	Bus.,	Plainfield, N. J.
Spalding, Fitzhugh Preston,	M.E.,	Marquette, Mich.
Stahl, Harry Ernest, jr.,	B.A.,	Trenton, N. J.
Stauffer, Willis Keiter,	Bus.,	Bethlehem.
Stazinski, Peter Felix,	M.E.,	Plymouth.
Stelle, Kenneth Lawrence,	Bus.,	Jamaica Plain, Mass.
Storer, John Waddell, jr.,	Bus.,	Wheeling, W. Va.
Stott, Frank Janney,	Bus.,	Philadelphia.
Stover, Arthur Platt,	Ch.E.,	Wilmington, Del.
Street, Theodore Emerson,	N.E.,	Rocky River, O.
Su, Harry Fang Piu,	E.M.,	Amoy, China.
Taylor, Louis Richmond,	E.E.,	Vineland, N. J.
Taylor, Robert Sayre, jr.,	B.A.,	Bethlehem.
Taylor, Thomas Frederic,	C.E.,	Bangor.
Thomas, Williams Howard Holland,	B.A.,	New Haven, Conn.
Thornburg, Richard Beaumont,	B.A.,	Bethlehem.
Titus, Charles Fischer,	B.A.,	Closter, N. J.
Torrance, George,	E.M.,	Pontiac, Ill.
Trumbore, Clark Richard,	B.A.,	Bethlehem.
Trushel, Willard Carl,	B.A.,	Warren.
Tyler, Walter Simeon, jr.,	Ch.E.,	Bridgeport, Conn.
Underwood, Lloyd Fletcher,	Ch.E.,	Chatham, N. J.
Unkles, John Jacob,	Bus.,	East Orange, N. J.
VanNostrand, Erwin Skidmore, jr.,	M.E.,	Toms River, N. J.
Verlenden, John Boyd,	C.E.,	Darby.
Volkmar, Karl,	C.E.,	Williamsport.
Waldron, John Wesley,	Ch.E.,	Philadelphia.
Walker, William Higham,	E.M.,	Riverside, N. J.
Wallace, Kenneth Campbell,	Ch.E.,	Bridgeport, Conn.
Waltman, John Richard,	B.A.,	Bethlehem.
Wardell, Weston Burnet,	Bus.,	East Orange, N. J.
Washburn, Lindsley Morgan,	Bus.,	Wilkes-Barre.
Weissenborn, Albert Edward,	E.M.,	Montclair, N. J.
Welch, Hiester Jacob,	N.E.,	Elmira, N. Y.

Wettereau, Paul Christian,	Ch.E.,	Hazleton.
Williams, Laurens Augustine Peter,	E.E.,	Woodstock, Vt.
Wilmot, George Lincoln,	Met.,	Hazleton.
Wolcott, Leslie Carl,	E.E.,	Warren, O.
Wurster, Luther Conrad,	E.E.,	Harrisburg.

FRESHMAN CLASS

Class of 1926

	Course	Residence
Alden, Charles Whiting,	E.M.,	Steelton.
Allard, Charles Norman,	Ch.E.,	Wildwood, N. J.
Althouse, Ernest Emanuel,	E.E.,	Hamburg.
Alwine, John Crock,	Bus.,	Greensburg.
Ambler Charles Merrill,	Bus.,	Abington.
Anderson, Paul Sutro,	Bus.,	New York, N .Y.
Applegate, William McLean,	E.E.,	Red Bank, N. J.
Ash, Charles Elwood, jr.,	M.E.,	Kingston.
Atwood, Henry Martyn,	E.E.,	New Rochelle, N. Y.
Aykroyd, Marshall John,	M.E.,	Bethlehem.
Ayers, Elwood Bowers, jr.,	M.E.,	Melrose Park.
Bachman, George, jr.,	C.E.,	Camden, N. J.
Bachman, Joseph Peter, jr.,	Bus.,	Allentown.
Bates, David Brooks,	M.E.,	Beaver.
Bauer, Fred Arthur,	B.A.,	Lakewood, N. Y.
Bayard, Arnold Aaron,	M.E.,	Philadelphia.
Bell, Davitt Stranahan,	M.E.,	Pittsburgh.
Bigley, James Warren,	E.E.,	Kingston.
Binai, Rong,	E.E.,	Bangkok, Siam.
Bingle, Francis Xavier,	Bus.,	New York, N. Y.
Bishop, Bruce Hunter,	M.E.,	Scranton.
Board, Cornelius Zabriskie,	E.E.,	Ridgewood, N. J.
Bond, Nelson Leighton,	Bus.,	Caldwell, N. J.
Borneman, Walter Houck,	E.E.,	Millville, N. J.
Boush, Gilbert Wesley,	E.M.,	Harrisburg.
Bradley, Frederick William,	B.A.,	Trenton, N. J.
Bridge, Ernest Laithwaite,	B.A.,	Glen Ridge, N. J.
Brill, Fred Augustus, jr.,	Ch.E.,	Swarthmore.
Brinser, Donald Christian,	Ch.E.,	Harrisburg.
Broome, Ross Alexander,	Bus.,	Scranton.

Brown, Leroy Augustus,	C.E.,	Allentown.
Brown, Willard Marshall,	Ch.E.,	Palmerton.
Brown, William Nicholas,	E.E.,	Brooklyn, N. Y.
Buell, David Clinton, jr.,	E.M.,	Middletown, N. Y.
Buenning, Carl Anthony,	E.E.,	Easton.
Bunnell, Nelson Smith,	Bus.,	Dalton.
Burgess, Henry Russell,	C.E.,	Pittsburgh.
Burlingame, Gordon Matthew,	M.E.,	Bryn Mawr.
Burnham, William,	N.E.,	Harrisburg.
Bushar, Harold Gordon,	C.E.,	Pottsville.
Butler, Joseph Paul,	Bus.,	Pittsburgh.
Cahill, John Joseph,	B.A.,	New York, N. Y.
Campbell, James Edward, jr.,	Ch.E.,	New York, N. Y.
Canfield, Donald,	Bus.,	Caldwell, N. J.
Carruth, Clarence Edgar, jr.,	Bus.,	DuBois.
Case, Rowland Bertram,	M.E.,	Phillipsburg, N. J.
Cetina, Renan,	E.E.,	Vera Cruz, Mexico.
Chadwick, Howard Cornelius,	Bus.,	Woodbury, N. J.
Chew, Edmund Freeman,	M.E.,	Mantua, N. J.
Childs, Frank Lawton,	Bus.,	New York, N. Y.
Childs, James Lawton,	Bus.,	New York, N. Y.
Clark, Ralph Waldo,	M.E.,	Factoryville.
Coleman, Fred Edward,	Bus.,	Northampton.
Comstock, Clinton Samuel,	M.E.,	Glenrock, N. J.
Cooke, Theodore, 3rd,	Bus.,	Pikesville, Md.
Coombs, Melville Martin,	M.E.,	Brooklyn, N. Y.
Cornwell, Edward Fahnestock,	C.E.,	West Chester.
Corson, Osman Myron,	E.E.,	Cape May Court House, N. J.
Cottman, William Watson, jr.,	M.E.,	New Hope.
Couch, Leonard Huguenor,	Bus.,	Buffalo, N. Y.
Cree, Walter Mitchell,	Bus.,	Pittsburgh.
Cressman, Paul Kreidler,	B.A.,	Bethlehem.
Cresswell, Herbert,	M.E.,	Scranton.
Cryder, William Adams,	E.E.,	Berwick.
Cumming, Benjamin Wilson,	Bus.,	Pottsville.
Cyphers, Kenneth Alexander,	M.E.,	Bethlehem.
Dalgleish, Robert Hamilton, jr.,	M.E.,	Washington, D. C.
Dancy, John Lloyd,	C.E.,	Phoenixville.
Davis, Clyde, 2nd,	Bus.,	Pittsburgh.

DeHart, Charles Thompson,	Bus.,	Thorofare, N. J.
DeLong, William Fox,	E.E.,	Philadelphia.
DeWitt, William Carpenter, jr.,	M.E.,	Phillipsburg, N. J.
Dietrich, Henry Buckley,	Bus.,	Baltimore, Md.
Dunn, Robert Clarence,	C.E.,	Park Ridge, N. J.
Dutt, Loris Merrill,	B.A.,	Bangor.
Dwyer, William Joseph,	Bus.,	Bethlehem.
Dyson, Robert Harris,	E.E.,	Washington, D. C.
Eagleton, Sterling Paul,	M.E.,	Cleveland, O.
Earle, John Goldsborough,	N.E.,	Easton, Md.
Elliott, Lewis Charles, jr.,	C.E.,	York.
Ellis, Franklin Griffith,	Ch.E.,	Allentown.
Enstice, Lyall Robert,	Bus.,	Arlington, N. J.
Epstein, Benjamin Maurice,	Bus.,	Easton.
Evans, Merle Albert,	E.M.,	Ebensburg.
Faga, Edgar Monroe,	Bus.,	Bethlehem.
Farley, Walter Reynolds,	Bus.,	Erie.
Ferris, Irving Miester,	M.E.,	New York, N. Y.
Fitzgerald, Edward Francis,	E.E.,	Northport, N. Y.
Flammer, Russell Bernhard,	Bus.,	Bethlehem.
Forbes, Joseph Palmer,	C.E.,	Chambersburg.
Ford, John Albert,	B.A.,	Phoenixville.
Fouchaux, Julien Ellis,	E.E.,	Paterson, N. J.
Fountain, Robert Fielder, jr.,	Bus.,	South River, N. J.
Fraivillig, Leonard Martin,	C.E.,	Bethlehem.
Frasca, Modestino John,	B.A.,	Stamford, Conn.
Frauenheim, Richard Joseph,	Bus.,	Pittsburgh.
Freeman, Robert Edgar,	Bus.,	Camden, N. J.
Friebely, Carl Daniel,	Bus.,	Bethlehem.
Fulton, Arthur Logan,	B.A.,	Catasauqua.
Gardner, George William Fall,	Bus.,	New York, N. Y.
Geyer, Philip, 3rd,	B.A.,	Brooklyn, N. Y.
Gibb, John Valentine,	E.E.,	Haddon Heights, N. J.
Giles, Edward Maynard,	Ch.E.,	Paterson, N. J.
Gill, Albert Benoist, jr.,	N.E.,	Bell Buckle, Tenn.
Glass, Samuel Kenelm,	Bus.,	Northampton.
Glenn, Graeff William,	M.E.,	Elkins Park.
Godshalk, Gerald Desmond,	E.M.,	Lansdale.
Goldstein, Samuel,	B.A.,	Atlantic City, N. J.
Gordon, Malcolm Kenneth, jr.,	E.E.,	Warrenton, Va.

Gorgas, Charles Crawford,	Bus.,	Paterson, N. J.
Griesemer, David Elias,	M.E.,	Allentown.
Griffiths, Thomas Sharpe,	M.E.,	Plymouth Meeting.
Grim, Harry Roberts,	B.A.,	Shelly.
Gunther, Frank Joseph,	Bus.,	Brooklyn, N. Y.
Haas, Charles Francisco,	E.E.,	Mexico.
Haefecker, George Augustus,	B.A.,	Tamaqua.
Halteman, Austin Shaffer,	C.E.,	Allentown.
Hanlon, James Paul,	E.E.,	Freeland.
Harley, John Scott,	M.E.,	Coatesville.
Harris, Arthur Digley,	C.E.,	Hackensack, N. J.
Harris, Murray Duncan,	E.M.,	Marquette, Mich.
Hartke, John Joseph, jr.,	E.E.,	Elk Ridge, Md.
Havens, James Curtis,	Bus.,	Bridgeport, Conn.
Hayes, Daniel Frank, jr.,	E.E.,	Paterson, N. J.
Heath, Donald Austin,	E.M.,	Jersey City, N. J.
Hendershott, Harold Clark,	E.M.,	Newton, N. J.
Henke, Herman John,	E.E.,	Honesdale.
Henry, Alvan LeRoy,	Bus.,	Flemington, N. J.
Henry, Gerald Boyd,	B.A.,	Buffalo, N. Y.
Herman, Morgan Frederic,	Bus.,	Middletown, N. Y.
Hess, Harry Charles,	Bus.,	Massillon, O.
Hoffman, Kenneth Landes,	E.M.,	Vintondale.
Holloway, Albert Marks,	B.A.,	Alden Station.
Holmes, John Middleton,	Met.,	New York, N. Y.
Hornbaker, Donald Griffin,	M.E.,	Clark's Summit.
Hotchkiss, Clarence Francis,	Bus.,	Binghamton, N. Y.
Huaman, Filiberto,	M.E.,	Lima, Peru.
Hubbard, Sheldon Crouter,	E.M.,	Palma Sola, Fla.
Hunter, Joseph Eastham,	Ch.E.,	Philadelphia.
Huyette, Samuel Louis,	Bus.,	Philadelphia.
Jackson, Joseph Gray,	Ch.E.,	Bala.
Jarvies, Edward Aloysius,	Met.,	East Orange, N. J.
Jedlicka, Frank Eugene,	E.E.,	Baltimore, Md.
Jennings, Albert Edward	C.E.,	Bethlehem.
Johnsen, Ernest Andrew,	Chem.,	Warren.
Johnston, Walter Baer,	Bus.,	Schuylkill Haven.
Kear, Frank Gregg, jr.,	E.E.,	Minersville.
Keen, Frank Porter,	Bus.,	Baltimore, Md.
Keller, Charles Ferdinand,	Ch.E.,	Harrisburg.

Kempf, Arthur William,	Ch.E.,	Bethlehem.
Kennedy, Richard Morris,	E.E.,	Lansford.
Kenworthey, William Bartle, jr.,	B.A.,	Milford.
Kiefer, Elmer Joseph,	E.E.,	Stroudsburg.
King, Frederick William Forbes,	M.E.,	Glen Head, N. Y.
Knerr, Russell Peter,	B.A.,	Allentown.
Knipe, Septimus Leon,	C.E.,	Bethlehem.
Kutz, Samuel Edward,	M.E.,	Easton.
Lang, George Isaac,	M.E.,	Brooklyn, N. Y.
Laramy, William John,	E.M.,	Altoona.
Law, Hartland,	Ch.E.,	Camden, N. J.
Lesh, Stogdell Stokes,	E.E.,	South River, N. J.
LeVan, James Henry,	C.E.,	Minersville.
Levin, Nathan,	M.E.,	Trenton, N. J.
Lewin, Henry,	Bus.,	Malden, Mass.
L'Hommedieu, Paige Drake,	Bus.,	New Brunswick, N. J.
Light, John Dirks,	B.A.,	Lebanon.
Linck, Robert Charles,	C.E.,	Philadelphia.
Lister, William Harry,	M.E.,	Rockville Centre, N.Y.
Loebell, Richard E.,	Ch.E.,	New York, N. Y.
Long, George Davis,	C.E.,	Bolivar.
Looker, Kenneth Estler,	Bus.,	Boonton, N. J.
Louden, John Franklin, jr.,	M.E.,	Amityville, N. Y.
Loyd, William Fisher,	E.E.,	Gary, Ind.
Lucente, Romeo Julius,	Bus.,	Bethlehem.
Ludwig, Richard Gustave,	Bus.,	Philadelphia.
Lum, Philip Livingston Swinnerton,	Bus.,	Chatham, N. J.
McBride, John Joseph, jr.,	M.E.,	Hazleton.
McCance, Edward Gilmour,	B.A.,	Bethlehem.
McCormick, Neil James,	Met.,	Bethlehem.
McDermott, Charles Bernard,	E.E.,	Allentown.
McFarlan, Alden Irving,	M.E.,	Bayonne, N. J.
McGoldrick, Hugh Francis,	Bus.,	Medford, Mass.
McKenzie, Frank Russell,	M.E.,	New York, N. Y.
McLean, Louis Alexander,	Bus.,	Chester.
McMahon, Rogers Dudley,	E.E.,	Sewickley.
Mackey, Theodore William,	E.E.,	Bethlehem.
Maiese, Domenick,	E.E.,	Camden, N. J.
Manuel, David Fuller,	C.E.,	Philadelphia.
Mapes, Harold Edward,	Bus.,	Glen Ridge, N. J.

March, Robert Carl Richard,	Bus.,	Philadelphia.
Marcus, Morey,	Bus.,	Paterson, N. J.
Mastriani, Samuel Gabriel,	C.E.,	Dunmore.
Mattern, Robert Jones, jr.,	Bus.,	Huntingdon.
Maxwell, John Walter, jr.,	N.E.,	Philadelphia.
Meden, Frederick Elof,	E.E.,	Chatham, N. J.
Mercur, Frederic,	B.A.,	Hazleton.
Merrill, Howard Elwood,	B.A.,	Garrett.
Meurer, Louis George, jr.,	Bus.,	Flushing, N. Y.
Meyers, Edgar Janvier,	E.E.,	Bridgeton, N. J.
Meyers, William Earl,	Bus.,	East Stroudsburg.
Michelena, Damian German,	N.E.,	Lima, Peru.
Miller, Gordon Blair,	Bus.,	Huntingdon.
Miller, Harold Wilson,	M.E.,	Wellsville, N. Y.
Miller, Mahlon Martin,	M.E.,	Sinking Spring.
Miller, Raymond Reeves,	Ch.E.,	Roanoke, Va.
Miller, William James,	Bus.,	Bethlehem.
Mong, Donald McMillan,	E.E.,	Erie.
Monteverde, Francis,	E.E.,	Lambertville, N. J.
Morris, James Reed, jr.,	N.E.,	Pittsburgh.
Morris, Stanford Runyan,	E.M.,	Bristol.
Morrison, James Robert Burns,	M.E.,	Auburn.
Nagle, George Samuel,	E.E.,	Abbottstown.
Neuman, Morton,	B.A.,	Bethlehem.
Nicholas, Charles William,	B.A.,	Butler.
Nicholson, Charles Houston,	Ch.E.,	Bethlehem.
Nitchie, Spencer Holmes,	C.E.,	Cranford, N. J.
Nony, Joseph George,	Bus.,	Brooklyn, N. Y.
Oliver, Donnell N.,	Bus.,	Pittsburgh.
Olwine, John Clayton,	Ch.E.,	Newark, N. J.
Osborn, Howard Milton,	E.E.,	Vineland, N. J.
Oswald, Ernest Paul,	M.E.,	Lancaster.
Pakenham, Edward Dudley, jr.,	B.A.,	Brooklyn, N. Y.
Partridge, Harvey Kelsey, jr.,	B.A.,	Merchantville, N. J.
Pease, George Warren,	Bus.,	Ridgewood, N. J.
Pease, Morris Gabriel,	M.E.,	Steelton.
Perry, John Richard Pattison,	E.E.,	Centreville, Md.
Phillips, Forrest Edwin,	Ch.E.,	Bethlehem.
Phillips, Lockwood,	B.A.,	West Pittston.
Phyfe, Herbert Lloyd,	C.E.,	New York, N. Y.

Pierce, Dewey Lockwood,	B.A.,	Brooklyn, N. Y.
Pierce, Ira Elford,	E.E.,	Peckville.
Poliska, Stephen George,	C.E.,	Taylor.
Pollack, Edward Wells,	Bus.,	New York, N. Y.
Poor, Benjamin Wood,	E.E.,	Glendale, O.
Potteiger, George Milton,	B.A.,	Hamburg.
Presbrey, Clifton Hyde, jr.,	E.M.,	Arlington, N. J.
Prior, Charles Malcolm,	Bus.,	Ridgewood, N. J.
Purcell, William Wendall,	C.E.,	Plainfield, N. J.
Pursel, Robert Newton,	M.E.,	Danville.
Raine, Robert Newton,	M.E.,	Scranton.
Randles, Merritt Emmet,	Met.,	Ogdensburg, N. Y.
Rankin, William Price,	Ch.E.,	Phoenixville.
Rapp, Howard Heath,	B.A.,	Philadelphia.
Rathbone, William Vinton,	Chem.	Parkersburg, W. Va.
Rebmann, Henry Bertram,	E.E.,	Philadelphia.
Reinoehl, John Benjamin,	Bus.,	Tremont.
Rerig, Eugene Lyons,	E.E.,	Hazleton.
Reusch, Walter George,	Ch.E.,	Richmond Hill, N. Y.
Reynolds, Thomas Francis,	M.E.,	Bethlehem.
Rhoades, Benjamin Richard,	Bus.,	Flushing, N. Y.
Rich, Herbert William,	E.M.,	East Orange, N. J.
Richman, Edwin, jr.,	E.E.,	Haddon Heights, N.J.
Rickerich, John Howard,	Bus.,	New York, N. Y.
Rigg, Edward Fletcher,	Bus.,	Burlington, N. J.
Ripalda, Emilio Augusto,	Bus.,	Quito, Ecuador.
Ritter, Stewart Elwood, jr.,	M.E.,	Allentown.
Roberts, Charles Bayard,	C.E.,	Mt. Vernon, N. Y.
Roberts, John Eldon,	Bus.,	Buffalo, N. Y.
Robinson, Hugh Wilson,	Bus.,	Bethlehem.
Robinson, Thomas Edmond,	B.A.,	Trenton, N. J.
Rodgers, William Berleau,	B.A.,	Bellevue.
Roeder, Elton Mohr,	E.E.,	Bethlehem.
Rush, Frank Schuyler,	B.A.,	Southampton.
Sall, George Leonard,	Bus.,	Philadelphia.
Sarson, Harry Fowler,	Bus.,	East Orange, N. J.
Sauerbrun, Irving Nelson,	C.E.,	Elizabeth, N. J.
Sawyer, Leonard Koewson,	E.E.,	Swarthmore.
Schellenger, Edward Augustus York,	B.A.,	Camden, N. J.

Schmidt, John Henry,	M.E.,	Morristown, N. J.
Schmoyer, Paul William,	Bus.,	Allentown.
Scholly, Francis Roydon,	B.A.,	Bethlehem.
Schuhle, Frank Frederick,	Bus.,	Brooklyn, N. Y.
Schulman, Maurice,	Bus.,	Bayonne, N. J.
Schwartz, Siegmund Philip, jr.,	E.E.,	Bridgeport, Conn.
Schwimmer, Herman Victor,	Bus.,	Brooklyn, N. Y.
Scott, Wilson Winfield, jr.,	E.E.,	Catasauqua.
Scrivener, Samuel, jr.,	E.M.,	Washington, D. C.
Seaman, Herbert Henderson, jr.,	Bus.,	Plainfield, N. J.
Seeley Harold Morris,	Bus.,	Keansburg, N. J.
Shaheen, Philip Joseph,	Bus.,	Cranford, N. J.
Shapiro, Julian Lawrence,	B.A.,	New York, N. Y.
Shartle, John Adam,	M.E.,	Franklin, O.
Shellenberger, John,	M.E.,	Bayonne, N. J.
Sheppard, Kenneth Anthony,	C.E.,	Bridgeton, N. J.
Shiner, Mervin Righter,	B.A.,	Bethlehem.
Shipley, Herbert Mapes,	E.E.,	Brooklyn, N. Y.
Shoup, Raymond Arthur,	E.E.,	Reading.
Shuhart, John Henry,	E.E.,	Bethlehem.
Sigler, Lucius Martin,	Bus.,	Cleveland, O.
Smith, Charles Edward,	Chem.,	Bethlehem.
Smith, Frederic Calvin,	B.A.,	Pen Argyl.
Smith, Gilbert Robert,	E.E.,	Jeddo.
Snyder, William Cordes, jr.,	E.M.,	Snow Shoe.
Sparks, Robert,	E.E.,	Far Rockaway, N. Y.
Stein, Emil,	B.A.,	Bethlehem.
Stephens, Fred James,	C.E.,	Franklin, N. J.
Stevens, William Ronald,	C.E.,	Hackensack, N. J.
Stillman, Charles Allen, jr.,	Bus.,	Akron, O.
Stofan, Andrew,	B.A.,	Eckley.
Stofflet, Millard Abraham,	B.A.,	Nazareth.
Swartz, Albert Eugene,	E.M.,	East Stroudsburg.
Taylor, Charles Gibson,	E.E.,	Pittsburgh.
Terwilleger, David Lydecker,	C.E.,	Wyckoff, N. J.
Thompson, William Andrew, 3rd,	B.A.,	Brooklyn, N. Y.
Thorpe, Gardner Belknap,	Bus.,	Babylon, N. Y.
Trainer, Robert Leonard,	C.E.,	Irvington, N. J.
Travis, Frank Glen,	N.E.,	St. Michaels, Md.

Travis, John Thurston,	B.A.,	Paterson, N. J.
Tyson, John,	B.A.,	Princeton, N. J.
Valega, Raul Felix,	E.E.,	Lima, Peru.
Varga, Vincent Ignatius,	B.A.,	Bethlehem.
Vennel, Charles Reed,	Bus.,	Camden, N. J.
Waesche, William Henry, jr.,	Bus.,	Baltimore, Md.
Walters, Emerson LeRoy,	Bus.,	Bethlehem.
Walters, Walter Brittain,	B.A.,	Newark, N. J.
Washington, William de Hertburn,	E.E.,	Riverton, N. J.
Watson, Charles Wilbur,	E.E.,	Madison, N. J.
Watters, John Waldner,	B.A.,	Ashland.
Weaver, Russell,	C.E.,	Allentown.
Weinstein, Benjamin,	B.A.,	Philadelphia.
Weiser, Charles Kistler,	Bus.,	Fullerton.
Wetzel, Roland Martz,	B.A.,	Bethlehem.
White, Henry Brooks,	E.M.,	Philadelphia.
Wickes, Robert Boal,	B.A.,	Mt. Vernon, Va.
Widdowfield, William Crippen,	E.E.,	Clark's Green.
Williamson, Henry Thelebert,	E.M.,	Phillipsburg, N. J.
Wills, James Henderson,	B.A.,	Belleville.
Winchester, Robert Caskey,	B.A.,	Phoenixville.
Wintermute, Gerald Hiles,	E.E.,	Newton, N. J.
Yeager, James Roland,	Bus.,	Reading.
Zug, Charles Keller, jr.,	E.E.,	Philadelphia.
Zurn, Oliver Franklin, 3rd,	Ch.E.,	Philadelphia.

SPECIAL STUDENTS

	Course	Residence
Blough, Arthur Paul,	E.E.,	Johnstown.
Dyche, James Albert,	Bus.,	Towaco, N. J.
Fernandez, Carlos Alberto,	E.M.,	Buenos Aires, Argentina.
Grossman, Walter,	B.A.,	Philadelphia.
Johnson, Benjamin Roger,	Bus.,	Long Beach, Cal.
Moore, James William, jr.,	Met.,	Selma, Ala.
Overlander, Rufus Melvin, jr.,	Bus.,	New York, N. Y.
Patton, Edward Thomas,	M.E.,	Philadelphia.

Potts, George Eckert,	Bus.,	Reading.
Rabinowitz, Simcha,	B.A.,	Brooklyn, N. Y.
Ricapito, Joseph,	B.A.,	Philadelphia.
Schatz, George W.,	E.E.,	Perkasie.
Shen, Dzu-Kun,	Ch.E.,	Hankow, China.
Spiehler, Augustine Merle,	Bus.,	Rochester, N. Y.
Tibolt, Frank Leo,	B.A.,	Bethlehem.
Ziegenfuss, Charles Edwin,	Bus.,	Bethlehem.

STUDENTS IN EVENING SCHOOL OF BUSINESS ADMINISTRATION

The following list includes non-matriculated students who are pursuing courses in the Evening School of Business Administration, described on pages 135-137. The courses in which the students are enrolled are indicated by numbers: 1, Advertising; 2, Accounting Theory and Practice; 3, Business Law; 4, Cost Accounting; 5, Business Finance; 6, Economics.

	Course	Residence
Achenbach, Thomas S.,	2, 3	Nazareth.
Achey, Howard Addison,	4	Bethlehem.
Amrhein, Irving Sterling,	4, 6	Bethlehem.
Alexy, Paul John,	1	Bethlehem.
Atwood, Laurence Charles,	1	Bethlehem.
Bader, Harry Walker,	4	Bethlehem.
Bader, William Charles,	2, 3	Bethlehem.
Baer, John George,	4, 5	Allentown.
Bieber, Truman I.,	4	Bethlehem.
Biehn, Horace L.,	2, 3	Bethlehem.
Birk, Robert Matthias,	5, 6	Bethlehem.
Bitting, Willard P.,	1	Bethlehem.
Bock, Adolph H.,	1, 2, 3	Bethlehem.
Brendle, Herman D.,	4, 5	Bethlehem.
Bush, Frank Royce,	1	Bethlehem.
Clewell, Eschor Barton,	2, 3	Nazareth.
Coffin, Stanley N.,	1, 4, 6	Bethlehem.
Dech, Warren Stoudt,	2, 3	Nazareth.
DeLong, Thomas Frederick,	1, 3	Bethlehem.
Diehl, George,	4	Bethlehem.
Ditterline, Roy E.,	4, 6	Bethlehem.

Doggett, Egbert B., C.E., (*Washington and Lee University*)	4, 6	Bethlehem.
Dorney, Edwin Heberly,	1	Allentown.
Dougherty, James William,	2, 3	Bethlehem.
Dudman, Charles William,	2, 3	Bethlehem.
Eberhart, Isaac K.,	4, 6	Bethlehem.
English, Willard R.,	4	Bethlehem.
Everett, LeRoy Charles,	4, 6	Bethlehem.
Fleischman, Ernest C.,	1, 6	Bethlehem.
Ford, Leslie,	2, 3	Bethlehem.
Haehnle, Edward D.,	4, 6	Bethlehem.
Handwerk, Russell Frank,	2, 3	Bethlehem.
Hanlon, Charles,	2, 3	Bethlehem.
Hecker, Samuel Sherman,	5, 6	Bethlehem.
Heiney, Samuel,	2, 3	Nazareth.
Herstine, Augustus Edward,	4, 5	Bethlehem.
Hicks, James Edward,	2, 3	Allentown.
Hursh, John J.,	4, 6	Bethlehem.
Jacobs, Charles E.,	4, 5	Bethlehem.
Jess, William Henry, E.E., (*University of Pennsylvania*)	1	Bethlehem.
Jones, Lloyd B.,	6	Bethlehem.
Kellow, Walter W.,	2, 3	Easton.
Kern, Clarence Thomas,	2, 3	Allentown.
Kommiller, Clarence H.,	1	Bethlehem.
Krohn, Louis,	1, 2, 3	Easton.
Kunkel, Luther G. N.,	4, 6	Allentown.
Lazarus, William Charles, jr.,	1	Bethlehem.
Litsch, J. M.,	1	Bethlehem.
McLay, Thomas Atkinson,	4	Bethlehem.
Mack, Clarence C.,	3, 4	Bethlehem.
Marsteller, Frank K.,	1	Bethlehem.
Metz, Victor Hoch,	2, 3	Nazareth.
Middleton, T. George,	1	Bethlehem.
Miller, Charles Reinhart,	1	Bethlehem.
Morrison, William,	2, 3	Bethlehem.
Musselman, Floyd R.,	2, 3, 4	Easton.
Otrosina, John Clyde,	2, 3	Bethlehem.
Phillips, J. M.,	1	Bethlehem.
Porter, Clarence Henry,	2, 3	Bethlehem.

Refowich, Harold G.,	2, 3, 5	Bethlehem.
Reichel, Clarence H.,	1	Bethlehem.
Reider, Freeman W.,	4, 5	Bethlehem.
Reis, Morton,	1	Bethlehem.
Ruyak, George Joseph,	4	Bethlehem.
Schaeffer, R. Paul,	4, 5	Allentown.
Schmell, Charles H.,	3, 5	Bethlehem.
Schmidt, Charles B.,	2, 3	Bethlehem.
Seiders, Ralph Ray,	4	Bethlehem.
Sellers, George E.,	4	Bethlehem.
Shiverdecker, Walter McKinley,	1	Allentown.
Smith, Ashton Ernest,	1	Bethlehem.
Smith, Samuel Ringer,	1, 4	Bethlehem.
Snyder, Richard G.,	2	Bethlehem.
Talbot, Peter J.,	1	Bethlehem.
Wallower, Clarence Irvin,	4, 5	Bethlehem.
Wanamaker, W. C.,	1	Bethlehem.
Weikel, Charles Henry Harrison,	4, 5	Bethlehem.
Wilde, Ralph Edgar,	2, 3	Bethlehem.
Youngken, Harold H. N.,	4	Allentown.

STUDENTS IN EXTENSION COURSES

The following list includes non-matriculated students who are pursuing collegiate or postgraduate courses from among those listed on pages 129-134 of this Register.

The courses in which students have been enrolled are indicated by numbers as follows: Educational Psychology, 1; Educational Sociology, 2; Principles of Education, 3; History of Education, 4; Secondary Education, 5; Educational Measurements, 6; School Administration, 7; Project Method, 8; Contemporary American Literature, 9; Speech Correction, 10; Education of Subnormal Children, 11; Psychology of Subnormal Children, 12; Advanced Mental Diagnosis, 13; General Geology, 15.

SUMMER SESSION AT LEHIGH UNIVERSITY

	Course	Residence
Adams, Isabel,	10,	Philadelphia.
Armpriester, Helen,	10,	Harrisburg.
Bishop, Louise Antoinette,	10,	Bethlehem.

Borst, Beatrice,	10,	Philadelphia.
Bowman, Blanche,	10,	Philadelphia.
Brownrigg, Jeanette,	10,	Brooklyn, N. Y.
Carroll, Clara, B.A.,	13, 14,	Bethlehem.
Chadwick, Gertrude,	10,	Philadelphia.
Christ, Mary Elizabeth,	10,	Altoona.
Davis, Mrs. Serena Foley,	10,	Philadelphia.
Dissinger, Elizabeth,	10,	Moorestown, N. J.
Drake, Esther,	10,	Philadelphia.
Erb, Russell Caspar,	3,	Conshohocken.
Everett, Cora E.,	10,	West Chester.
Fink, William LeRoy,	1, 3,	Slatington.
Forbes, Elizabeth A.,	10,	Philadelphia.
Frankenberger, Margaret,	10,	Philadelphia.
Gabriel, Sara,	10,	Coopersburg.
Gendall, Grace,	10,	Philadelphia.
Gerst, Helen M.,	10,	Altoona.
Hanigan, Alice,	10,	Philadelphia.
Harper, Robert M.,	1,	Bethlehem.
Hauser, Roderick Ritter,	1,	Allentown.
Hazlett, Helen Steel,	10,	Philadelphia.
Hedding, Margaret M.,	10,	Altoona.
Hitchner, Belle,	10,	Philadelphia.
Hollis, Ella Louise,	10,	Philadelphia.
Jeffers, Margaret,	10,	Philadelphia.
Jones, Elsie M.,	10,	Easton.
Kendall, Esther,	10,	Webster Mills.
Kennedy, Jamieson Douglas,	1,	Bethlehem.
Kessler, Mabel,	13,	Reading.
Kraemer, Olga,	10,	Philadelphia.
Kremer, Elizabeth,	10,	Philadelphia.
Linck,	1, 3,	Slatington.
Lindenmuth, S. Louise,	10,	Reading.
Lorsbach, Elizabeth,	1, 3,	Allentown.
McCormick, Mildred,	10,	Harrisburg.
McNelis, Grace,	10,	Glen Lyon.
Mackay, Martha,	10,	Philadelphia.
Mayer, Marie C.,	10,	Philadelphia.
Miller, Helen A.,	10,	Easton.
Miller, Kathryn Elizabeth,	1, 3,	Alpha, N. J.

Morris, Emma L.,	10,	Philadelphia.
Morris Jennie F.,	10,	Reading.
Murphy, Alice Lewis,	10,	Philadelphia.
Nies, Viola,	10,	Philadelphia.
Parrot, Caryl S.,	10,	Philadelphia.
Paul, Florence Ruth,	1, 3,	Easton.
Rice, Velma Louise,	10,	Easton.
Ruffenbach, Louise,	10,	Philadelphia.
Schick, Myrtle,	10,	Allentown.
Schmittel, Nell B.,	10,	Altoona.
Scureman, Margaret,	10,	Kingston.
Snyder, Anne G.,	10,	Altoona.
Souter, Ruth Jean,	10,	Indiana.
Spahn, Emma H.,	10,	Reading.
Taylor, Robert Norman, B.A.,	1, 3,	Hellertown.
Tyson, Sara E.,	10,	West Chester.
Vignola, Rose Anna,	10,	Philadelphia.
Villee, Sallie Helen,	10,	Bethlehem.
Webb, Charlotte B.,	10,	Philadelphia.
Wilson, Ethel V.,	1, 3,	Alpha, N. J.
Wilson, Judd W.,	10,	Newark, N. J.
Zerweck, Ethel,	1,	Bethlehem.

SUMMER SESSION AT THE TRAINING SCHOOL OF VINELAND, N. J.

	Course	Residence
Allen, Margaret,	12, 13,	Akron, O.
Anastasia, Sister Mary,	12, 13,	Jefferson, Wis.
Bourke, Elizabeth,	12, 13,	Waterbury, Conn.
Campbell, Catherine,	12, 13,	Houston, Tex.
Coleman, Ida,	12, 13,	Honesdale.
Dare, Edith,	12, 13,	Woodcliff-on-Hudson, N. Y.
Ek, Mrs. Anna M.,	12, 13,	Brockton, Mass.
Estes, Marion,	12, 13,	Rochester.
Fleming, Betty G.,	12, 13,	Torrington, Conn.
Forsyth, Mary E.,	12, 13,	Batavia, N. Y.
Galbraith, Letty,	12, 13,	Spartanburg, S. C.
Hayes, Mary,	12, 13,	Torrington, Conn.
Heller, Mrs. Hannah M.,	12, 13,	East Stroudsburg.
Henry, Janet P.,	12, 13,	Jersey City, N. J.

Hoesley, Emma B.,	12, 13,	Yakima, Wash.
Hopler, Bernice D.,	12, 13,	Bartley, N. J.
Hoss, Alma,	12, 13,	Indianapolis, Ind.
Howarth, Mrs. Henriette,	12, 13,	Newark, N. J.
Hughes, Mrs. Helen,	12, 13,	Perry, N. Y.
Kugler, Edna M.,	12, 13,	Harrisburg.
Lashley, Elizabeth,	12, 13,	Centerville, Ind.
McNally, May E.,	12, 13,	Jersey City, N. J.
McQullen, Pauline,	12, 13,	Pittsburgh.
Madeline, Sister Mary,	12, 13,	Jefferson, Wis.
Pagaud, Elizabeth,	12, 13,	New Orleans, La.
Perkins, Jeanette,	12, 13,	Baltimore, Md.
Smull, Alice L.,	12, 13,	Danville.
Thorpe, Amy,	12, 13,	Highgate, London, Eng.
Trible, Diordre,	12, 13,	Evansville, Ind.
Vail, Marjorie,	12, 13,	Evanston, Ind.
Vail, Mrs. Sophia B.,	12, 13,	Evanston, Ind.
Walker, Mabel Stuart,	12, 13,	Petersburg, Va.
Watkins, Lida,	12, 13,	Baltimore, Md.

FIRST TERM, 1922-1923

	Course	Residence
Allen, Dorothy,	4,	Bethlehem.
Amrheim, Virginia,	8,	Bethlehem.
Baas, Florence Edith,	8,	Bethlehem.
Babcock, Mary Kirk,	6, 7,	Bethlehem.
Bachert, Charles W.,	2,	Bethlehem.
Balliet, Kate S.,	8,	Bethlehem.
Beary, Joyce Elizabeth,	9,	Allentown.
Beattie, Marjorie, A.B.,	1,	Bethlehem.
Belzer, Mary Elizabeth,	2,	Bethlehem.
Benner, Emma Susan,	4,	Bethlehem.
Briody, Catherine Beatrice,	2,	Bethlehem.
Brown, Mrs. Ella Van Dyke,	2,	Bethlehem.
Buckley, Ella Veronica,	2,	Bethlehem.
Burke, Nellie Elizabeth,	2,	Bethlehem.
Clark, S. Naomi,	2,	Bethlehem.
Conlin, Mary,	2,	Bethlehem.

Conner, Anna Evelyn,	2,	Bethlehem.
Crow, Mary Matilda,	8,	Bethlehem.
Drohan, Margaret Agnes,	2,	Bethlehem.
Dwyer, Mary Margaret,	2,	Bethlehem.
Eagan, Eleanora Frances,	2,	Bethlehem.
Erb, Elsie N.,	2,	Bethlehem.
Fairchild, Enola,	9,	Bethlehem.
Fegley, Claude A.,	1,	Bethlehem.
Fisher, Carrie Cecilia,	8,	Bethlehem.
Folk, Mrs. Hannah Elizabeth,	2,	Bethlehem.
Forrest, Martha C.,	4,	Bethlehem.
Fox, Catherine,	2,	Bethlehem.
Gallagher, Mary Genevieve,	2,	Bethlehem.
Ganly, Gertrude F.,	2,	Bethlehem.
Gavin, Mrs. Emma,	2,	Bethlehem.
Haytock, Mae Evelyn,	1,	Bethlehem.
Heberling, Ella Louise,	4,	Bethlehem.
Heilman, Jennie M.,	2,	Bethlehem.
Hemsath, Elizabeth,	4,	Bethlehem.
Henry, Fannie,	2,	Bethlehem.
Herbin, Mabel,	2,	Bethlehem.
Hess, Lloyd Cornelius, B.A., (*Lehigh University*)	8,	Bethlehem.
Hildebrand, Agnes,	2,	Bethlehem.
Horne, Dorothy,	8,	Bethlehem.
Keefe, Nora,	2,	Bethlehem.
Kleckner, Ruth Emma,	1,	Bethlehem.
Kramer, Eileen Lois,	5, 7,	Coplay.
Krause, Anna Catherine,	8,	Bethlehem.
Krause, Blanche I.,	8,	Bethlehem.
Kressler, Helen Roseberry,	4,	Finesville, N. J.
Kunsman, Mamie E.,	4,	Bethlehem.
Laubach, Stewart Lorine,	2,	Bethlehem.
Long, Evelyn E.,	8,	Bethlehem.
Long, Violet E.,	8,	Bethlehem.
Lopp, Mildred,	1,	Nazareth.
Loesbach, Elizabeth M.,	2, 8,	Bethlehem.
Lucey, Mary Elizabeth,	2,	Bethlehem.
Luchenbach, Martha Olga,	8,	Bethlehem.
McBride, Annie,	2,	Bethlehem.

McGuinness, Elizabeth,	2,	Bethlehem.
Mack, Edith Lydia,	4,	Bethlehem.
Maley, Mary,	2,	Bethlehem.
Merwath, Marjorie Geraldine,	2,	Bethlehem.
Metzger, Charlotte Elizabeth,	1,	Reading.
Miller, Georgena,	8,	Bethlehem.
Miller, Mary F.,	1,	Bethlehem.
Miller, Regina G.,	2,	Bethlehem.
Mitman, Esther Froueta,	1,	Bethlehem.
Morshumer, Lina Elizabeth,	2,	Bethlehem.
Mueller, Margaret Joan,	1,	Bethlehem.
Murray, Annie Victoria,	4,	Bethlehem.
Murray, Marion H.,	4,	Bethlehem.
Nolf, Laura A.,	4,	Bethlehem.
Post, Hazel Dell,	2,	Bethlehem.
Ressler, Laura E.,	8,	Bethlehem.
Riley, John David,	1,	Bethlehem.
Roberts, Gertrude May,	8,	Bethlehem.
Schroeder, Julia,	8,	Bethlehem.
Shunk, Marion Helen, B.A.,	1, 6,	Bethlehem.
Silberman, Carolyn Theresa,	2,	Bethlehem.
Solt, Ada,	15,	Bethlehem.
Stroman, Angie C.,	2,	Bethlehem.
Swartz, Ruth A.,	8,	Bethlehem.
Taylor, Robert Norman, B.A.,	5,	Bethlehem.
Thomas, Hannah Victoria,	2,	Bethlehem.
Torpey, Elizabeth Geraldine,	2,	Bethlehem.
Vaughn, Amy,	4,	Bethlehem.
Weber, Dorothea,	1,	York.
Weil, Emma Catherine,	4,	Bethlehem.
Weiser, Abby Catharine,	4,	Bethlehem.
Wilcox, Evelyn Florence,	2,	Bethlehem.
Worman, Claire,	8,	Bethlehem.
Zell, Harry Allen,	1,	Bethlehem.

SUMMARY OF STUDENTS BY CLASSES AND COURSES

	* Graduates	Seniors	Juniors	Sophomores	Freshmen	Specials	Totals
Arts & Science	27	21	38	36	51	4	177
Business Adm..	5	20	35	41	89	6	196
Civil Eng.....	3	35	24	22	31		115
Mech. Eng.....	4	27	29	29	47	1	137
Mining Eng....	1	27	29	25	19	1	102
Metallurgy.....	1	12	13	10	4	1	41
Electric. Eng...	1	36	29	28	61	2	157
Chemistry.....	6		1	2	3		12
Chem. Eng.....		21	20	38	20	1	100
Naval Eng.....		6	5	8	7		26
Totals.....	48	205	223	239	332	16	1063

*Graduate students are listed in the department in which they are taking their major subject.

Students in Evening School of Business Administration. 79
Students in Extension Summer Session, 1922..... 98
Students in Extension Courses, First Term, 1922-23... 89

Total 266

GEOGRAPHICAL SUMMARY OF STUDENTS

Alabama	1
Arkansas	1
California	2
Colorado	1
Connecticut	16
Delaware	2
District of Columbia	27
Florida	4
Georgia	1
Illinois	7
Indiana	1
Maryland	39
Massachusetts	10
Michigan	7
Missouri	1
New Jersey	204
New York	111
North Carolina	1
Ohio	15
Oregon	1
Pennsylvania	563
Rhode Island	4
South Carolina	1
Tennessee	1
Texas	1
Utah	2
Vermont	1
Virginia	8
West Virginia	7
Wisconsin	1
Wyoming	1
Argentine Republic	1
Brazil	1
China	5
Colombia	1
Cuba	1
Ecuador	1

Greece	1
Mexico	3
Peru	4
Siam	1
Venezuela	2
	1062

INDEX

Administrative Officers, 16
Admission of Students, 19, 22
  Requirements, 19
Advanced Standing, Admission to, 21
Almanac, 2
Alumni Association, 177
Alumni Prizes, 178
  Award in 1922, 168
Alumni Prizes for Oratory, 178
Arboretum, 165
Arts and Science Club, 167
Arts and Science, College of
  Description, 32
  Requirements for admission, 19
  Schedules of Studies, 34-37
  Undergraduate courses, 77
Assistant Professors, 10
Associate Professors, 8
Astronomy
  Graduate courses, 138
  Observatory, 161
  Undergraduate courses, 94
Athletic Field, 164
Biology
  Graduate courses, 144
  Undergraduate courses, 110
Buildings, 151
Business Administration, College of
  Description, 41
  Evening School, 135
  Graduate courses, 140
  Requirements for admission, 19
  Schedule of studies, 43
  Undergraduate courses, 80
Calendar, 3
Callender Fellowship, 175
Carson Prize, 176
Certificates, 22
Chandler Chemical Laboratory, 152
Chandler Chemistry Prizes, 176
  Award in 1922, 169
Chemical Engineering, Course in
  Description, 69
  Requirements for admission, 19
  Schedule of studies, 73
Chemistry, Course in
  Description, 66
  Graduate courses, 146
  Requirements for admission, 19
  Schedule of studies, 68
  Undergraduate courses, 121
Christmas Hall, 160
Civil Engineering, Course in
  Description, 44
  Graduate courses, 148
  Requirements for admission, 19
  Schedule of studies, 47
  Undergraduate courses, 95
College Commons, 163
Conference Department, 16, 129
Coppee Hall, 160
Coxe Memorial Fund, 175
Coxe Memorial Library, 162
Coxe Mining Laboratory, 159
Departmental Societies, 166
Dormitories, 162
Drown Memorial Hall, 163
Economics
  Graduate courses, 140
  Undergraduate courses, 80
Economic Geography, 84
Education
  Graduate courses, 145
  Undergraduate courses, 78
Electrical Engineering, Course in
  Description, 61
  Graduate courses, 142
  Requirements for admission, 19
  Schedule of studies, 65
  Undergraduate courses, 116
Electrical Eng. Prize, 176
  Award in 1922, 169
Engineering Societies, 166
English
  Graduate courses, 139
  Undergraduate courses, 92
Examinations, Entrance, 20
  Examinations at schools, 23
Expenses, 150
Extension Courses, 129
Faculty, 6
  Committees, 17
Forestry, 110
Founder's Day, 167
Frazier and Ringer Memorial Fund, 181
Fritz Engineering Laboratory, 158
French
  Graduate courses, 146
  Undergraduate courses, 89
Geology
  Graduate courses, 143
  Undergraduate courses, 106
German
  Graduate courses, 143
  Undergraduate courses, 88
Graduate Courses
  Admission to, 22, 137
  List, 138
Greek
  Graduate courses, 141
  Undergraduate courses, 87
Gymnasium
  Description, 163
  Physical education, 128
Haines Scholarship, 174
History
  Graduate courses, 140
  Undergraduate courses, 84
Honor List, 1922, 169
Honor System, 167
Honorary Scholarship Societies, 166
Instructors, 13
Italian
  Graduate courses, 146
  Undergraduate courses, 91

Latin
Graduate courses, 149
Undergraduate courses, 85
Lecturers, 10
Lectures, 166
Library
University Library, 162
Officers of, 17
Coxe Memorial Library, 162
List of Studies
Graduate courses, 134
Undergraduate courses, 77
Mathematics
Graduate courses, 138
Undergraduate courses, 94
Mechanical Engineering,
Course in
Description, 48
Requirements for admission, 19
Schedule of studies, 51
Undergraduate courses, 99
Mercur Scholarships, 174
Metallurgy, Course in
Description, 52
Graduate courses, 149
Requirements for admission, 19
Schedule of studies, 55
Undergraduate courses, 103
Military Science and Tactics, 126
Mining Engineering, Course in
Description, 56
Graduate courses, 142
Requirements for admission, 19
Schedule of studies, 60
Undergraduate courses, 112
Museums, 165
Observatory, 161
Packer Hall, 151
Packer Memorial Church, 17
Description, 161
Services, 167
Philosophy
Graduate courses, 145
Undergraduate courses, 78
Physical Education, 128
Physics
Graduate courses, 147
Undergraduate courses, 114
Physics Laboratory, 153
Political Science, 83
Portuguese, 91
Pre-Medical Course, 37-38
Price Hall, 163
Price Prize, 176
Prickitt Scholarship, 174
Prizes
Alumni Prizes, 178
Carson Prizes, 176
Chandler Prizes, 176
Electrical Engineering Prize, 176
Price Prize, 176
Wilbur Prizes, 176
Williams Prizes, 179
Professors, 6
Psychology
Graduate courses, 145
Undergraduate courses, 77
Romance Languages, 89
Saucon Hall, 160
Sayre Observatory, 161
Sayre Park, 165
Scholarships
Coxe Memorial Fund, 175
Haines Scholarship, 174
Mercur Scholarship, 174
Prickitt Scholarship, 174
Wilbur Scholarship, 174
Williams Fund, 175
Ship Construction and Marine Transportation, Course in
Description, 74.
Graduate courses, 148.
Requirements for admission, 19
Schedule of studies, 76
Undergraduate courses, 124
Site of the University, 151
Spanish
Graduate courses, 146
Undergraduate courses, 91
Students, List of, for 1922-1923, 182
Graduate Students, 182
Seniors, 185
Juniors, 190
Sophomores, 196
Freshmen, 202
Special Students, 210
Extension Course Students, 213
Summary of Students:
By Classes and Courses, 219
By Geographical representation, 220
Studies, List of, 77
Summer Term, 136
Taylor Field, 164
Taylor Gymnasium, 163
Taylor Hall, 162
Teachers' Courses, 38
Theses, 168
Trustees, 4
Committees, 5
Honorary Alumni Trustees, 4.
Officers of the Board, 5
Tuition, 150
Undergraduate Courses, 77
University Day, 168
University Sunday, 167
Wilbur Engineering Laboratory, 155
Wilbur Prizes, 176
Award in 1922, 168
Wilbur Scholarship, 174
Award in 1922, 168
Williams Fund, 175
Williams Hall, 156
Williams Prizes, 179
Y. M. C. A., 167

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